# NHS England Midlands virtual ward evaluation project

# Literature review on barriers and facilitators to implementation of virtual wards

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#### **Executive Summary**

The healthcare landscape within the NHS is evolving rapidly, driven by the increasing pressure on urgent and emergency care systems. To address these challenges, the concept of virtual wards is gaining prominence. Virtual wards represent a significant shift in the way acute medical care is delivered, offering patients hospital-level care in the comfort of their own homes. This approach not only augments healthcare capacity without the need for physical hospital expansion but also provides patients with an alternative to traditional inpatient care.

NHS England has defined virtual wards as a "safe and efficient alternative to NHS bedded care enabled by technology." A strategic plan was unveiled in 2021 to implement virtual wards across the NHS, with a focus on reaching specific targets by the end of 2023. Remote patient monitoring is playing a pivotal role in supporting the delivery of care within these virtual wards.

Whilst virtual wards are a relatively new concept, they share similarities with the well-established model of hospital at home, which has been adopted globally for over two decades. Both models emphasise the importance of delivering acute care outside traditional hospital settings, promoting patient comfort and reducing the burden on inpatient facilities. Remote patient monitoring, though primarily associated with chronic disease management, is becoming increasing integrated into the operation of these innovative healthcare models.

The inception of virtual wards was accelerated during the COVID-19 pandemic, where they proved to be a valuable tool in managing patients remotely. These wards focused on monitoring patients remotely with COVID-19, (e.g. with pulse oximetry) and intervened when specific thresholds, such as oxygen saturation levels, were met. As the pandemic unfolded, the concept expanded beyond respiratory infections to include various other medical conditions, offering an alternative to hospitalisation for patients who would otherwise require inpatient care.

Two distinct types of virtual wards emerged: Acute Respiratory Tract Infections (ARI) virtual wards and Frailty virtual wards, also referred to as Hospital at Home in NHS England's guidance. ARI virtual wards were designed to manage respiratory infections, including COVID-19, by providing patients with timely access to specialist care, diagnostics, and interventions, including oxygen therapy. These patients would later be discharged to primary care with clear follow-up plans. Frailty virtual wards, on the other hand, target patients over 65 with acute frailty syndromes. These wards aim to provide in-home care to patients who would otherwise require hospital admission.

To gather insights into the implementation of these healthcare models, a comprehensive literature search was conducted across various databases, including Medline, Web of Science, Embase and grey literature. The search focused on identifying studies that explored the barriers and facilitators of virtual wards, hospital at home, and remote patient monitoring. A total of 55 relevant articles and documents were identified.

The facilitators of these models encompassed several key areas:

**Covid-19 Pandemic**: The pandemic served as a catalyst for the rapid setup of Covid-19 virtual wards, prompting a collaborative approach between primary and secondary care, acceptance of novel working methods and

**Finances**: Some studies indicated cost savings in virtual ward models compared to traditional hospital stays, emphasising the financial advantages of these approaches.

**Policy Support**: NHS England produced documents to support the implementation of virtual wards, providing financial, technological, and workforce recommendations.

**Leadership and workforce**: Strong leadership was identified as crucial in articulating the value of providing care at home and managing financial impacts. Multidisciplinary team collaboration and upskilling were found to be important for successful implementation.

**Patient Preference**: Many patients preferred home-based care for reasons such as maintaining independence and quicker recovery.

**Technology**: Integration of electronic health records and communication tools improved efficiency and safety.

Conversely, barriers to implementation included:

Limited Evidence Base: There is a scarcity of evidence on the implementation of virtual wards, hospital at home and remote patient monitoring, particularly outside the COVID-19 context. Technology Challenges: Digital illiteracy, lack of internet access, data protection concerns, and technology costs posed barriers to some patients and healthcare providers. Challenges in implementing electronic health records and ensuring data security were also noted.

**Regulatory Hurdles**: Regulatory barriers and health system policies complicated the implementation process, especially in the US.

**Patient Eligibility**: Identifying eligible patients and convincing them to enrol in home-based care were challenging in some settings, along with medical criteria that were too restrictive. Some patients preferred the perceived safety of remaining in the hospital to opting for home based care. **Reimbursement**: Funding and reimbursement models for hospital at home services posed challenges in both private and public healthcare systems.

**Clinician Concerns**: Some clinicians had reservations about the safety and efficiency of home-based care, and physician hesitancy to refer patients was noted.

**Caregiver Burden**: Caregivers in home-based care sometimes experienced strain and felt that they lacked sufficient instructions and professionalism from nursing staff.

In conclusion, virtual wards, hospital at home, and remote patient monitoring represent innovative healthcare models that offer alternatives to traditional inpatient care. While these models have shown promise, they face challenges in their implementation. Strong leadership, a collaborative workforce, patient preference for home-based care, and policy support have been identified as facilitators. In contrast, limited evidence, technology challenges, regulatory hurdles, and issues related to reimbursement and clinician concerns present barriers. Further research and experience will be necessary to identify the broader picture for successful implementation.

#### Introduction

Hospital based care has been the mainstay of acute medical treatment within the NHS since its inception. With the increasing pressures on urgent and emergency care systems over the last decade, operational planners recognise that additional capacity is required in the system. One of the key policies currently being implemented to support this is the creation of virtual wards (1) offering patients hospital level care in their usual place of residence. As well as providing additional capacity without needing new bricks and mortar hospitals, virtual wards offer patients an alterative to inpatient bedded care in their usual place of residence.

NHS England has defined virtual wards as a "safe and efficient alternative to NHS bedded care that is enabled by technology" (2). In 2021 a strategy to implement virtual wards widely across the NHS was produced, encouraging all integrated care systems to have virtual wards based on their population size. This was expected to be rolled out at pace with funding being provided to integrated care systems and targets being set for services to reach by the end of 2023(2). In order to meet the technology enabled requirements many services have started to utilise remote patient monitoring to support their delivery of care (3).

The virtual ward programme as defined by NHS England is similar to another health delivery innovation called hospital at home. Hospital at home has existed as a mechanism of delivering acute care outside of the hospital environment globally for some 20 years or more. However, this has not been widely adopted in the UK, particularly in England. With the drive to implement virtual wards across England, there is much overlap with the hospital at home concept. Similarly, the use of remote patient monitoring has also been around for many years, although its primary focus has previously been on chronic disease management.

Given the rapid conceptualisation and roll out of virtual wards there is limited evidence in this space, particularly examining the implementation of these services. However, as hospital at home and remote patient monitoring has been in existence for longer, there is more evidence available which will be discussed further in this review.

#### Background

During the Covid-19 pandemic, it was recognised that some patients who tested positive for the virus could be remotely monitored in their own homes. NHS England sought to formalise this type of care and termed it as a "virtual ward" (4). These virtual wards were used widely and successfully to manage patients at home, with services gaining confidence in the complexity and acuity of patients they could safely manage. Services were set up and rolled out at pace utilising a variety of remote technologies to facilitate remote patient monitoring (5). The roll out was organised centrally through NHS England with example SOPs and pulse oximeters being sent to services free of charge. The majority of these virtual wards focused on monitoring of patients with a plan for escalation to hospital when patients met a specific threshold based on their oxygen saturations.

Subsequently the concept of virtual wards was expanded as it was recognised that other medical conditions could also be treated using this type of methodology. Virtual wards may provide an alternative to hospital admission or a safe pathway to early supported discharge for patients who require ongoing monitoring following a period of inpatient treatment. NHS England guidance specifically focused on frailty and acute respiratory tract infections (ARI) virtual wards initially,

however the key element is that the patients utilising these services would otherwise have required hospital admission (3).

The ARI virtual wards were designed to be built directly on the learning from the Covid virtual wards to support patients with a variety of respiratory infections including Covid (6). The policy guidance sets out expectations that ARI wards: remain clinically led with timely access to specialist input when required; have access to hospital level diagnostics and interventions including oxygen where required; ensure regular in-person or remote patient reviews and; discharge planning into primary care (7).

The frailty virtual ward which is also referred to as hospital at home in the NHS England guidance notes is aimed at patients over 65 with acute frailty syndromes (8). As with the ARI virtual wards, the focus is on treating patients at home who would otherwise have required hospital admission ensuring that clinical pathways, relevant staffing and appropriate clinical governance arrangements are all in place.

# Search strategy

Relevant literature to this review was identified using literature searching on a range of databases, references of references and through grey literature searches.

The search strategy included key words of virtual ward\*, hospital at home or hospital in the home, and remote monitoring. These were combined with the following phrases implement\*, barrier, facilitator, enable\*. These phrases were used in the following databases Medline, Web of Science, Embase over a range of dates between March and July 2023. A grey literature search was conducted using the internet search engine Google and the NHS future platform dedicated to virtual wards. Further references were identified from references of policy documents found through this grey literature search.

After identification of studies, they were screened for relevance from the abstract. We included studies that met the following criteria: Population – any persons requiring bedded care Intervention – virtual ward/hospital at home/remote monitoring Comparator – none required Outcome – what are the barriers and facilitators for establishing and using virtual wards, at a system, staff and patient level Study type – any, including grey literature and policy

Studies were combined on Mendeley and duplicate entries removed.

# Results

After screening, the search found 43 articles relevant to this review.

Table 1 shows the breakdown of studies by intervention type. In addition, there were a further 12 papers identified which include policy documents and editorials which are not categorised.

| Virtual Wards   | Hospital at Home   | Remote Patient Monitoring   |
|---|--|---|
| Annis et al., 2020<br>Croyden PCT and Kings Fund,<br>2006<br>Cushen et al., 2022<br>Hutchings et al., 2023<br>Fox et al., 2022<br>Lewis et al., 2017<br>Mantena et al., 2021<br>Norman et al., 2023<br>Nunan et al 2020<br>O'Malley et al., 2022<br>Salford Royal NHS Foundation<br>Trust, 2020<br>Schultz et al., 2021<br>Schachter et al., 2014<br>Vindrola-Padros et al., 2021<br>Wells et al., 2022 | Brody et al., 2019<br>Chua et al., 2022<br>Conley et al., 2016<br>Dismore et al., 2019<br>Gomez-Centurion et al., 2022<br>Gorbenko et al., 2023<br>Hassankhani et al., 2020<br>Lai et al., 2021<br>Leff et al., 2021<br>Leong et al., 2021<br>Kapedia et al., 2021<br>Karacaoglu et al., 1 2021<br>Kokol et al., 2023<br>McCurdy et al., 2020<br>Miller et al., 2018<br>Patel et al., 2021<br>Shepperd et al., 2021<br>Utens et al., 2014<br>Vale et al., 2020 | Aldahmash et al., 2019<br>Ferrua et al., 2020<br>Hidefjall et al., 2023<br>Kirkland et al., 2023<br>Ondiege et al., 2017<br>Rakers et al., 2023 |
|   |  |   |

#### Table 1. Studies by intervention type.

The identified studies were primarily small service evaluations or thematic review articles combining multiple evaluations. The focus of most papers was clinical effectiveness, safety and efficacy. Barriers and facilitators to implementation was the focus of one remote patient monitoring study and three hospital at home studies. One of these studies was based in the UK but was very focused on a COPD hospital at home, all the other studies were based in the US health system.

Although hospital at home, virtual wards and remote patient monitoring will be reported on separately in this review, it should be noted that some UK based review articles are using the evidence base interchangeably. Furthermore, some NHS England policy documents now include both hospital at home and virtual wards terminologies within them.

#### Virtual wards

Virtual ward care was originally described in the UK in 2006 by Croydon Primary Care Trust (PCT) where they provided case management in the community to patients to reduce unplanned hospitalisation (9,10). Over the years the definitions, descriptions and models of virtual wards have

changed , with some locations also referring to them as community wards (11). NHS England launched its latest virtual ward programme in 2021 following a successful remote monitoring programme for Covid-19 during the pandemic. The latest definition of a virtual ward has been expanded to encompass a safe and effective alternative to hospital admission, utilising technology (3).

Although there have been many successful examples of covid virtual wards published as case studies or service evaluations, there is very little in depth evidence exploring the implementation of virtual wards either during or after the covid pandemic. Much of the published literature describes Covid virtual ward outcomes with brief mentions of the set up or implementations processes undertaken.

Initially NHS England's focus on virtual wards was technology based, however, more recent policy documents include hospital at home terminology and methodologies (2,12).

We now proceed by describing the facilitators and enablers which are described within the literature review.

#### Facilitators

#### Covid-19 pandemic

The covid-19 pandemic acted as a facilitator for the set up of Covid-19 virtual wards to provide monitoring or ongoing care and treatment to patients discharged from an acute hospital setting. O'Malley et al., (13) highlight that a collaborative approach between primary and secondary care was important in the design of their service facilitated by the urgency presented during the pandemic. A further Covid-19 virtual ward describes using unique pathways allowing GPs to use point of care ultrasound in primary care to triage high risk patients into their virtual ward (14). This again was a change in working practices brought about by the pandemic. There are many other examples of Covid virtual wards being set up during the pandemic globally (15–17), however it is unclear from the literature how this has transitioned into the current virtual ward movement.

#### **Finances**

A community virtual ward established in Ireland for asthma and COPD patients identified that costs per day were considerably less for those under the virtual ward compared to acute hospital admission (18). A covid virtual ward also described a cost avoidance in terms of bed days and staffing (14), however this was not a primary outcome for the implementation of this service, instead aiming to ensure available inpatient bed spaces during the height of the pandemic. Norman et al. report that wider review of the evidence suggests that there is insufficient evidence to determine cost-effectiveness (19). However, the studies taken into account in this review include hospital at home models as well as virtual wards.

#### Policy

NHS England produced a variety of documents to support the implementation of virtual wards including a document aimed at intermediate care systems called enablers for success (3,12). This document focuses on the available finances, technology and workforce recommendations and governance and monitoring. Although this document lays out the enablers to implementation, these are evidenced with case studies only and do not reference a published evidence base. During the covid-19 pandemic an example Standard Operating Procedure (SOP) was produced which individual services could adopt to roll out services at pace (4). This has not been reproduced for the roll out of

frailty or respiratory virtual ward, although guidance notes for both specialties have been produced (6).

# Barriers

# Evidence base

Despite literature around remote patient monitoring for chronic conditions, O'Malley et al recognised at the time of implementation of their Covid-19 virtual ward there was limited literature available on the implementation of virtual wards providing continuing acute treatment to patients at home(13).

# <u>Technology</u>

A systematic review identified that the use of remote monitoring in a covid virtual ward was a barrier to recruiting some patients, due to digital illiteracy or lack of internet access (20). The largest patient cohorts included within this review were based within the US and the review also noted there were no examples of targeting patients in socially and economically disadvantaged groups. Within the equity related theme, cost or lack of internet availability was identified, as well poor health literacy and access to technologies such as smart phones were all identified as concerns (19). Norman et al. also identified that some remote technologies have caused concerns around data protection and privacy (19). It should be noted that many of the virtual wards included within this review were providing a purely remote monitoring service which would not meet the definitions of a virtual ward currently.

# NHS pressures

There has been much scepticism about the implementation of virtual wards from a variety of sources. The virtual ward programme has been seen a vehicle for increasing capacity across the NHS acute services (21). There continues to be sustained focus on increasing the capacity of existing virtual wards to 40-50 virtual beds per 100,000 of the population, with an 80% utilisation rate. Lasserson et al. report that pressures on the urgent and emergency care system cannot be solved in their entirety by virtual wards, however using them for suitable patient populations, in an appropriately staffed and resourced way can positively support these stretched systems (22).

# Hospital At Home

Hospital at home is concept that has been in existence for many years globally, although uptake and spread within the UK has been slower than other parts of the world. Studies have shown that many acute medical conditions can be successfully treated using this method (23). Despite this, a definition of what hospital at home is has only recently been published (24,25) following a consensus decision at the World Hospital at Home Congress in 2023. The UK Hospital at Home Society describes Hospital at Home as providing "intensive hospital-level care for acute conditions that would normally require an acute hospital bed, in a patient's home for a short episode through multidisciplinary healthcare teams" (25). Although this section focuses on hospital at home, most of these services would meet the criteria of a virtual ward laid out by NHS England.

Leff et al. surveyed participants of the first world hospital at home congress in 2019 to develop a research agenda for hospital at home. Although acknowledging a significant evidence base for hospital at home, one of the nine key research domains they identified on their agenda was

understanding the barriers and facilitators to implementation and scaling hospital at home programmes (26) highlighting the ongoing need for research in this area.

Gorbenko et al. identified multiple barriers and facilitators discussed below. However, they also identified that these often changed between the four stages of implementation: exploration; preparation; implementation and; sustainment (27).

# Facilitators

#### Leadership

Gorbenko et al. identified that experienced staff were more likely to apply for the waiver to implement hospital at home (27) in the USA. Leaders who were able to articulate the value of providing care at home were more successful with business cases and handling financial impacts. Brody et al identified that early development of partnerships and establishing co-ordination and communication between system partners supported the development of Hospital at home services (28). Leadership and a clear chain of command was also identified as a mechanism of improving communication within a hospital at home service, which also aids patient safety and successful patient outcomes (29).

#### <u>Workforce</u>

A Scottish study identified high staff satisfaction within the team, related to intra team collaboration, flat hierarchy and a focus on upskilling and additional training (30). A systematic review of reviews listed multidisciplinary team working as their key facilitator (31). This is supported by a Cochrane review in which multidisciplinary team working, access to a doctor, and 24-hour working were all identified as common themes (32). A randomised controlled trial using a multidisciplinary approach to comprehensive geriatric assessment at home (33) showed similar outcomes to inpatient hospital care, demonstrating a collaborative workforce facilitated home based care.

#### Condition specific guidance

The British Thoracic Society recommended an early support discharge model of hospital at home is appropriate for treatment of COPD exacerbations (34). It should, however, be noted that their definition of hospital at home in 2007 was more aligned to intermediate care, and may not meet current definitions. Despite this a more recent study used this as a basis to demonstrate safe care for COPD patients in hospital at home (35).

#### Patient preference

Dismore et al. looked at drivers and barriers of implementation of a COPD hospital at home programme. Patients reported a preference for home based care with perceived benefits of maintaining independence, quicker recovery, improved sleep quality and friends and family being close by (36). Conversely Patel et al. noted that convincing older adults that home care in the U.S. was as safe as hospital based care was a challenge for some services (29).

#### Technology

Kapedia et al. identified that integrated health records improved staff efficiency in providing safe, effective and timely care to patients. Electronic communication between hospital and community providers also supports robust discharge processes (37). Kokol et al. (38) found that the use of technology, in particular remote patient monitoring, could increase the acceptance of hospital at

home models to both patient and clinicians. However they also note that there is little literature currently published on the use of wearable technology in the hospital at home environment (38).

# Covid-19 Pandemic

A haematology hospital at home services was set up during the covid-19 pandemic to reduce the risk of patients with haematological malignancies from needing to attend hospital (39). They found significant effort across the multidisciplinary team was essential to the successful implementation of this hospital at home programme, and had been enabled through the unique context of the covid-19 pandemic which aided redeployment of additional staff.

# Barriers

# **Regulatory barriers**

In the US, Brody et al. looked at facilitators and barriers to implementation of a hospital at home program (28). Their key barrier was identified as developing systems for working within the regulatory barriers and health system policies. The complexity and extent of these varied from state to state, but consistently resulted in a variety of problems ranging from laboratory time to scope of healthcare professionals.

# Patient eligibility

Both Gorbenko et al. (27) and Brody et al. (28) found identification of eligible patients as a barrier to implementing and scaling up hospital at home programs. This often involved manual search for patients by clinical staff rather than relying on referrals from hospital clinicians. Medical criteria were also seen as a barrier where this was too restrictive or not updated to match advances in medical care.

In Leong et al.'s (31) literature review the need for patients to be medically stable was a barriers to eligibility for receiving hospital at home care. Being at home alone was considered a potential barrier by Dismore et al., primarily due to patient fear of being alone and unwillingness to accept social care support (36). Many hospital at home services also had a geographical catchment area that limited which patients were accepted into the programme (27) (31) (40). Patients also had to be willing to accept hospital at home care and Brody et al. noted scepticism from both patients and family members (28).

# Workforce

Gorbenko et al. identified staffing as a crucial element for enrolling patients into services, however some services struggled to recruit sufficient staff (27). Where this occurred alternatives such as leasing staff, hybrid in person/virtual appointments and focusing on urban areas were seen as alternative service options. Staff shortages were related to burnout following the covid-19 pandemic and variability of scope of practice regulations between states within the US (27).

# Medications/Pharmacy

In the US, access to medication was seen as a barrier to implementation, with challenges related to the location of medicines suppliers and chain of custody within the service (27). Brody et al. found access to medicines in community or outpatient settings were problematic for hospital at home services when supplied from order pharmacies primarily focused on delivering inpatient services (28). As well as supply of medicines, patients self-managing their medications whilst unwell was seen

as a risk, with medication errors or poor medication compliance listed as a challenge by Patel et al (29).

# **Funding**

In a UK based COPD study, concern was raised that patients treated at home do not attract a payment tariff. Study participants felt this could potentially prevent progression of this treatment model (36). In private healthcare systems in Iran, palliative hospital at home services do not attract a tariff, resulting in families feeling uncertain about insurance cover for this treatment type (41). In the US, many hospital at home programmes were developed following the CMS waiver<sup>1</sup>, however the future of this is still uncertain after its expiration in December 2024. Alternative funding avenues need to be explored to ensure the sustainability of the programmes if the waiver was discontinued (27). Patel et al. explain that for many US health systems, the incentive is to have patients in hospital beds to generate income, and hospital at home programmes are not reimbursed in many places (29).

#### Clinician concerns

Dismore et al. reported that physicians had a preconceived idea that hospital care was safer than hospital at home for the treatment of COPD (36). Within the same study nursing staff also initially reported a lack of confidence, however this increased with adequate training and support (36). In addition to this, some clinicians felt that their medical school and residency training did not fully prepare them for home based care, potentially contributing towards burnout in the medical workforce providing at-home care (29). Patel et al. summarised some of the main clinician concerns as malpractice risks, time constraints and reduced efficiency of care (29). This translates into a hesitancy from physicians to refer patients to a hospital at home service.

#### Patient Choice

In a US based study, patients offered hospital at home treatment were asked to explain reasons for non-enrolment (42). The most frequent reasons given were: fear of going home with a perceived safety of remaining in hospital and; ease of remaining in the hospital. Although the study found that patients choosing to enrol or decline had a similar sociodemographic, 63% of their eligible patients opted to decline hospital at home treatment (42). An Asian study also looked at patient perceptions of hospital at home treatment, with patients expressing operational concerns about at home care and a belief that in hospital care would be superior (43). A Canadian review also identified that some COPD patients preferred to receive their care as an inpatient rather than at home (44). However, it did note that patient satisfaction with treatment was equally high with both groups.

# Caregiver burden

The burden on the caregiver in the home was identified as being a potential barrier to implementation of hospital at home (37). A study looking at informal caregivers caring for COPD patients in a hospital at home programme found that the strain experienced by caregivers was similar to hospital based treatment, but caregiver satisfaction was greater in the hospital at home cohort (45). However, a study looking at caregivers in a palliative hospital at home services in Iran identified that caregivers felt they had been given insufficient instructions, experienced desperation

<sup>&</sup>lt;sup>1</sup> The Centers for Medicare and Medicaid Services (CMS) waiver programmes allow for states to make exceptions to the usual rules. During the Covid-19 pandemic a waiver was produced that reduced the need for 24 hour on site nursing care to be provided thereby allowing care to be provided in the home setting.

and witnessed a lack of professionalism from inexperienced nursing staff (41). The authors commented that without addressing these issues and implementing appropriate care protocols implementing home based palliative services would be difficult. Caregiver burden was also identified by Hospital at home stakeholders as a potential concern (46). While it was recognised that hospital at home offers care givers more opportunity to personalise patient care, they can often be left coordinating, organising or assisting in care.

#### Electronic health records

Access to electronic records similar to an inpatient system was described as an essential component of a successful programme by Gorbenko et al. (27). They detailed several services who were unable to enrol patients or had to delay go-live dates due to ineffectual or non-functioning electronic systems. Kapedia et al. also found that lack of integration of virtual health technologies with electronic health records did not support real time data exchange (37). Another study found that electronic health records were supportive for implementation, however noted that incorporating inpatient ordering elements for community settings was challenging during service set up (28).

#### **Remote Patient Monitoring**

Remote patient monitoring (RPM) has been used successfully for many years in the monitoring of chronic health conditions (47). A combination of patient questionnaires, remote sensors or wearable technology can send information remotely to clinicians allowing them to deliver remote consultations. During the Covid-19 pandemic, clinicians and managers recognised this type of technology may be suitable for monitoring and identifying deterioration in patients with acute covid-19 infections (48).

Much of the evidence discussed in this section focuses on the monitoring of chronic health conditions and these services would not likely fully meet the NHS England definition of a virtual ward.

#### Facilitators

#### <u>Workforce</u>

During the implementation of remote patient monitoring in Pakistan and Saudi Arabia, the skill of the workforce was commented upon as being important to deal with patient training and dealing with unforeseen complications (49). In a Dutch study, early interdisciplinary cooperation and continued stakeholder engagement throughout implementation was identified as a key facilitator (50). A rapid roll out of a remote monitoring programme for Covid-19 in the US was made possible by using a workforce of residents and medical students, who would otherwise have been sidelined during the pandemic, providing consistent monitoring and advice (48). A French study also included staff using the systems in the design process which they believed led to a more acceptable product for patients (51).

#### **Leadership**

Kirkland et al. studied RPM for diabetes across six clinics in the US, where they identified the commitment, visibility and accountability of the leaders and managers delivering the service as a key theme (52). Aldahmash et al. also found that strong leadership was important for the long term success of the remote monitoring programme (49)

#### Patient collaboration

Hidejfall et al incorporated literature on remote patient monitoring for chronic conditions with logic models to look at reasons for successful adoption. They identified that using logic involving patient collaboration led to shared management between healthcare providers and patient or relatives. They found that without this shared approach, many remote monitoring initiatives had failed (53).

#### **Finances**

Rakers et al. suggested that for RPM to be financially profitable, high-volume patients needed to be managed in this way. Suggestions for working across departments and across hospitals was suggested by Dutch healthcare insurers (50).

#### Covid-19 pandemic

A systematic review showed that remote patient monitoring was widely used for pre-hospital and step down monitoring of Covid-19 (20), internationally. Many of these services were set up and rolled out at pace to meet the demands of the pandemic. However, this review found that the majority of studies did not include consideration of either implementation barriers or facilitators.

# Barriers

#### Patient selection

Aldahmash et al. describe the implementation of a remote patient monitoring system in Pakistan and Saudi Arabia for patients with long term medical conditions. They found significant disparity across healthcare systems which led to variability in individuals' self-motivation to engage in the programme. Further to this, services only enrolled participants with sufficient English language skills and an appropriate level of digital literacy (49). A UK based study found that 31.5% of participants on their covid virtual ward were unable to use the technology required for remote patient monitoring (54). Some of the factors associated with this was advanced age and being non-English speaking, without an option to change the language on the device.

# **Reimbursement**

Rakers et al. examined the barriers and facilitators of structural reimbursement for RPM in the Netherlands. One of the main barriers identified was that the entity bearing the cost of the implementation did not receive the benefits. This even went as far as identifying a reduction in income to certain departments as patients would not be seen physically (50). Furthermore Rakers et al. identified that the Dutch healthcare system made cross sector reimbursement through insurance companies challenging (50).

#### Workforce

Although also identified as a facilitator to the implementation of remote monitoring during the Covid pandemic, Annis et al. also commented that having insufficient staffing provided a barrier to enrolling patients into the programme at peak times (48).

#### <u>Security</u>

Concerns have been identified around the security of patient identifiable data with both remote monitoring devices and the platforms used by healthcare professionals (55). Additionally there can be additional concerns around data protection and inadvertent data sharing when devices are passed between patients in multiuse devices.

# Conclusion

The concept of virtual wards is still new to the NHS healthcare system and consequently the evidence base on implementation barriers and facilitators is scant. Hospital at Home and remote patient monitoring have a larger evidence base, both of which are broadly applicable to the virtual ward programme. Nevertheless, this is mostly set in healthcare systems outside the UK.

The three models considered by this review, all emphasised the importance of individuals, workforce and leadership (27-31, 48,49,51,52) as a key ingredients for implementation, across all stages from initial planning and business case development, through to clinician and patient engagement during service establishment and development. When national leadership through policy and reimbursement schemes were available, this was seen as a facilitator to implementation., The importance of leadership is not a new phenomenon and has long been recognised as an important driver to successful implementation of healthcare innovation,

This review found that the covid pandemic was a critical facilitating factor in supporting virtual ward implementation with numerous authors (13-17,20,39) acknowledging that this unique context enabled services to be set up at pace (39). This literature recognises that changes in usual practice were more acceptable during this period (14,39) and that innovative models of healthcare were adopted more readily (14). Although not explicitly referred to in the evidence, we note that during the pandemic there was more available capacity to redeploy staff to establish such services (given the reduced provision of other routine healthcare services during this period). The literature covered in this review does not include any examples of services set up in the post pandemic period or how this has affected existing services.

The use of technology has been seen as both a barrier (19,20,27,37) and facilitator (37,38). Studies considering the use of technology identified within this review includes remote patient monitoring systems, but also electronic patient records, prescribing systems and access to point of care testing. Where this technology has been integrated well into services, it has been seen as a facilitator to delivering care through these methodologies (37,38). Some of the challenges identified include electronic security, cost, health literacy, and patient and clinician acceptability (27,28,37). However, the conditions which trigger these different enabling and disabling effects of technology are not clear.

We found that reimbursement for services has been identified as a barrier to many services being implemented (27,36,41). These are primarily observed in healthcare systems that are predominantly private or insurance based such as the US. However even within the NHS, hospital at home services have not been funded in the same way as inpatient care and this has been a challenge to implementing services (36).

Whilst the evaluation of hospital at home models have received the most research attention and have the strongest evidence base, healthcare researchers and health system providers recognise that further research is needed on the barriers and facilitators for implementation (26,27). As such understanding the antecedents and conditions necessary for implementation and scale up have been identified as a key research agenda by the world hospital at home congress (26).

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