SHTG Recommendations
June 2026

In response to an enquiry from the Scottish Government Unscheduled Care Team

Virtual ward platform technologies to support transition of patients to the home setting or to avoid hospital admission

Recommendations for NHSScotland

The current evidence base for virtual ward models of service delivery is limited and heterogeneous. Evidence on the added value of virtual ward platform technologies is inconclusive, and therefore their use should be accompanied by ongoing and systematic data collection.

When NHS boards implement virtual wards supported by virtual ward platform technologies, they should be offered as an optional alternative to either hospital admission or in support of earlier discharge. Virtual wards should be used only for patients who require ongoing monitoring and are clinically suitable for remote monitoring. Participation should be based on informed patient choice and consideration of patients' circumstances, including the potential burden on carers. This should be supported by clear and comprehensive discussions between clinicians and patients about risks, benefits and available alternatives.

In delivering virtual ward services, NHS boards should assess the suitability of a patient's home environment for this purpose, the availability of informal support, digital access and literacy, and any assistance required to use the technology. This is necessary to ensure the intervention is appropriate and that resources are used effectively.

Virtual ward platform technologies should not be expected to deliver benefit in isolation and should be implemented as an integral element of service delivery.

Remote monitoring devices used must be validated for use across diverse populations, including people with a range of skin tones. Clinical decision making should be informed by multiple measures rather than relying on a single data point.

The introduction of virtual wards should be supported by a structured evaluation framework to enable consistent and meaningful data collection. These data will be critical for assessing clinical and cost effectiveness and for informing future decisions on the scale and scope of national implementation.

NHSScotland is required to consider the Scottish Health Technologies Group (SHTG) recommendations.

What were we asked to look at?

We were asked to review the clinical effectiveness, cost effectiveness, safety and patient experience associated with the use of virtual ward platform technologies to manage patients who would traditionally require inpatient monitoring, either to support transition to the home setting or to avoid hospital admission.

Why is this important?

Virtual ward platform technologies enable hospital-level monitoring at home, with the potential to improve patient comfort, reduce infection risk and support recovery. At a system level, they may help ease the demand on inpatient beds and could contribute to more efficient use of resources by offering a potentially flexible approach to service provision. As only limited, local trials of virtual wards have taken place within NHSScotland, a robust assessment of the evidence is important in informing future decisions about the role and value of virtual ward models of service delivery.

What was our approach?

We reviewed the published literature on the clinical and cost effectiveness, patient experience and safety of virtual wards, with a particular focus on virtual ward platform technologies. We also gathered public opinion using a survey sent to approximately 1,000 people living in Scotland. More information about SHTG Recommendations is available on our website.

What next?

Our SHTG Recommendations will be shared with Scottish Government Unscheduled Care Team, and disseminated across NHSScotland to inform future decision making on the implementation of virtual wards across Scotland.

Key points from the evidence

Background

1. In NHSScotland, a virtual ward is a service delivery model in which patients are monitored at home with minimal face-to-face contact with healthcare professionals. It is used as either an alternative to hospital admission or to support earlier discharge. Virtual wards require dedicated and appropriately trained staff. Consultations with healthcare professionals are primarily conducted by telephone or online platforms. A range of virtual ward platform technologies is available to support this model of service delivery. These technologies typically consist of a patient-facing app or website associated with medical devices for recording symptoms and physiological measures, with a digital interface linking to healthcare professionals.

2. In NHSScotland, 'hospital at home' and 'virtual wards' are distinct service delivery models. This is different to the wider literature and NHS England where the terms are used interchangeably. In NHSScotland, hospital at home is an established model delivering short-term, acute-level hospital care in a patient's home or a home-like environment. In contrast, virtual wards are generally less intensive service delivery models, focusing on remote monitoring with escalation of care when clinically required. This SHTG Recommendation is about the virtual ward platform technologies used to support virtual ward models of service delivery.

Clinical evidence

3. The current evidence base for virtual wards supported by virtual ward platform technologies is limited in both quantity and quality. Although the models described in the literature broadly align with the NHSScotland definition of a virtual ward, no two studies evaluated the same service delivery model. There was considerable variation across studies in virtual ward service design, components, and the type and intensity of monitoring provided. This heterogeneity makes it difficult to attribute outcomes to specific elements of the service model, particularly the contribution of the virtual ward platform technologies themselves. Interpretation of the evidence is further complicated by inconsistent terminology, most notably the interchangeable use of the terms 'virtual ward' and 'hospital at home'.

4. Most of the studies focused on outcomes such as hospital admissions, readmissions, length of stay and mortality. Clear or consistent patient selection criteria are lacking. The studies primarily involved patients with respiratory or other acute conditions, limiting generalisability. While the limited evidence suggests that outcomes for patients managed in virtual wards appear comparable to those for patients managed in hospital wards, the specific added value of virtual ward platform technologies remains unclear. This reflects the

fact that studies generally assessed whole models of service delivery, making it difficult to isolate the effects of the platforms from other components of care.

5. A comprehensive systematic review of 69 studies (describing 63 interventions) found low-certainty evidence indicating no difference in hospital readmission rates between patients receiving technology-enabled care at home and those receiving inpatient hospital care.[1] Similarly, limited mortality data suggested no difference in survival. The review stated that it remains unclear whether virtual ward platforms offer additional benefits compared with telephone or video conferencing within home-based care models.

6. The National Institute for Health and Care Excellence (NICE) guidance published in 2023 on virtual ward platform technologies for people with acute respiratory infections was based on 19 studies encompassing 6,129 people. Sixteen studies were case series and 17 were on people with COVID-19.[2]

   NICE concluded that there was no significant difference in outcomes (including length of stay, admissions, readmissions and escalation of care) between patients monitored on virtual wards compared with hospital wards. Mortality rates were low and there was no indication of safety concerns. NICE noted that the evidence base was limited by a lack of robust, comparative data from the United Kingdom (UK), and generalisability of the findings was constrained because of study heterogeneity and a predominant focus on people with COVID-19.

7. We identified six additional primary studies published since the NICE guidance and the systematic review (ranging in size from 46 participants to over 3,000).[3-8] Five were observational studies and one was a mixed-methods evaluation. The studies varied in size and quality and only two included a comparison group. Two studies included a clinically mixed patient population. The participants in the remaining studies were people with acute heart failure, atrial fibrillation, post-surgical patients or people with COVID-19. Reported outcomes included hospital readmissions, mortality, length of stay and escalation of care. Although the methodological limitations of these studies mean that firm conclusions cannot be drawn, their findings are broadly consistent with the secondary evidence, suggesting that outcomes for people monitored on virtual wards may be comparable to those for people monitored in hospital wards.

8. NHS Borders piloted a virtual ward for patients with respiratory disease from January to March 2024. The ward supported 50 people over a 10-week period. Patients were monitored remotely using wearable devices and a clinical dashboard, with daily virtual reviews. Despite some implementation challenges (for example, a reliance of locum staff and limited operating hours), feedback from patients and staff was positive. An estimated 236 hospital bed days were avoided and 84% of patients reported feeling safe and well supported at home.

Economic evidence

9. The available economic evidence for virtual wards is limited and firm conclusions on cost effectiveness cannot currently be drawn. Available studies suggest that virtual wards could potentially enable more efficient use of resources, based on patients being discharged sooner from hospital and lower readmission rates, but further data are required to assess costs and benefits robustly.[2, 4, 9, 10]

Public perception, patient experience and equality issues

10. We used a survey to gather public perceptions of virtual wards in Scotland. The survey was sent to 963 people. Of the 377 respondents, most understood the concept of virtual wards (82%) and felt confident using technology with appropriate support (78%). The majority (65%) were comfortable with home-based monitoring.

    If given a choice, 44% of respondents said they would prefer virtual ward monitoring at home versus 25% who would prefer monitoring within hospital, with 31% unsure. Those preferring virtual wards valued being at home with clinical oversight. Those favouring hospital care emphasised safety and immediate access to staff. Respondents who were unsure indicated that their preference would depend on the condition and the reliability of support.

11. From the literature, virtual ward technologies are generally well accepted by patients, with perceived benefits including greater comfort, autonomy and a reduced risk of hospital-associated complications. Virtual ward models of service delivery are not suitable for everyone and individual preferences, home environments and levels of support must be carefully considered. Qualitative evidence highlights the importance of clinician interaction, as well as the need for training and support for patients and their carers to address digital exclusion and reduce anxiety about using remote-monitoring technologies.[2, 11-14]

12. Virtual ward models of service delivery may risk disproportionately excluding groups such as older adults, people experiencing homelessness, those with low income or disabilities, and individuals with either limited digital access or skills. Additional considerations include cultural or language barriers.[2, 11-14]

13. There are known limitations of certain monitoring devices, for example pulse oximeters may be less accurate in people with medium to dark skin tones. This underlines the importance of device validation across diverse populations and the use of multiple measures to inform clinical decisions.[2, 11-14]

Implementation considerations

14. A 2025 qualitative systematic review identified key factors influencing virtual ward implementation, including the need for skilled remote-working staff, clear protocols,

sufficient resources, strong leadership and supportive professional culture.[11] The NICE early value assessment highlighted poor interoperability with electronic patient records as a key implementation barrier and similar challenges may be relevant within NHSScotland.[2, 13]

SHTG Council considerations

1. The Council recognised the complexity of the topic and the associated evidence base. In particular, the substantial variation in virtual ward delivery models was recognised as limiting the interpretability of the evidence and complicating the formulation of clear, generalisable recommendations.

2. The Council heard expert input from two clinical topic experts from NHS England and a representative of the Roy Castle Lung Cancer Foundation.

3. A clinical expert described how remote monitoring can take many different forms depending on the clinical context, the condition being monitored and the technologies used. Monitoring may be continuous or intermittent. The expert highlighted that the term ‘virtual ward’ is not consistently understood and may be confusing for patients in terms of what the model involves in practice.

4. Clinical experts questioned the suitability of the NHSScotland virtual ward model for widespread application across patient groups. They noted that hospital admissions are rarely for monitoring alone and more commonly reflect multiple clinical needs. From this perspective, experts advised that remote monitoring may be better framed as one of several enabling approaches supporting a broader shift away from hospital-centred care towards care delivered in community settings.

5. The Council noted expert advice on the importance of the type of technology used for remote monitoring, particularly the distinction between active and passive approaches. Active technologies require patients or their carers to take physiological measurements (such as blood pressure or oxygen saturation) and to enter or transmit the data themselves. This can place additional demands on patients and carers, relies on correct technique, and may increase the risk of missing or inaccurate data, especially for people with limited digital confidence, cognitive impairment or fluctuating health status. In contrast, passive technologies such as wearable electrocardiogram (ECG) or physiological monitoring patches, require minimal active input from patients. These technologies may therefore be more acceptable and accessible for some patients and carers, reduce the burden of self-management and lower the risk of errors in data collection or reporting.

6. The representative from the Roy Castle Lung Cancer Foundation highlighted the vulnerability and anxiety experienced by many patients following discharge after lung cancer surgery. Virtual ward monitoring was described as having the potential to provide reassurance, reduce feelings of isolation and support patients, many of whom will have co-existing chronic conditions, through the remote monitoring of vital signs. Technologies enabling early identification of complications and timely intervention were valued by patients and carers and may help reduce avoidable readmissions.

7. The Council noted that informal carers often play an important role in supporting people who use virtual ward platform technologies. Carers may assist with monitoring signs and symptoms, as well as facilitating communication with healthcare teams. The Council recognised that this support may increase caregiver burden and requires appropriate consideration, training and support within service design.

8. The Council agreed that the value of virtual ward platform technologies is likely to depend on how effectively they are implemented and integrated into service delivery. The Council drew on insights from the evaluation of the NHS Borders respiratory virtual ward pilot, noting that technologies should not be expected to deliver benefits in isolation and must be:

    a. aligned with service needs

    b. embedded within clearly defined care pathways

    c. supported by appropriate clinical oversight, sufficient workforce capacity and robust operational processes.

9. The Council acknowledged that the term 'virtual ward' is used inconsistently and has the potential to cause confusion, particularly for patients and the public. It was also recognised that virtual ward platform technologies are already in use in NHSScotland, including within hospital at home pathways, adding complexity to decision making in this area.

10. The Council discussed sustainability considerations and sought the views of the clinical experts. Experts advised that some remote monitoring devices can be reused following appropriate decontamination, depending on device type. They also noted that virtual ward models may contribute to reduced carbon dioxide emissions, primarily through reduced patient travel and fewer emissions associated with inpatient hospital stays.

11. The Council discussed the findings of the Citizen's Panel survey and highlighted the value it added to this work. The demographics of respondents were considered, with the Council acknowledging that the use of an electronic survey may have led to an over-representation of individuals who are already comfortable using digital technology. This limitation was recognised by the authors of the Citizen's Panel report. The Council also noted the under-representation of respondents aged under 45, and of those living in social or private rented accommodation, while recognising that survey responses were weighted by age and housing tenure to mitigate this imbalance.

12. The Council acknowledged the lack of robust economic evidence to inform its considerations. This was viewed in the context of the heterogeneity of service models and the difficulty of defining discrete models from which costs and cost effectiveness can be reliably estimated. The Council highlighted the importance of further evidence generation to support future decision making in this area.

Contents

Definitions

Abbreviations used in this document are listed in *Appendix 1*.

Hospital at Home: in this SHTG Recommendation, hospital at home is defined as an acute clinical service that delivers hospital-level care in a patient’s home (including their own home, a relative’s home or a nursing home). This includes the staff, equipment, technologies, medications and clinical skills usually provided, and delivered face-to-face, during an inpatient hospital admission.

Step-down care: care provided in the home setting to patients discharged early from hospital.

Step-up care: care provided to patients in the home setting to avoid hospital admission.

Virtual Ward: in this SHTG Recommendation, a virtual ward involves monitoring patients at home, with minimal face-to-face contact between the patient and a healthcare professional, as an alternative to hospital admission or to enable earlier discharge. It is distinct from ‘hospital at home’ and focuses on remote monitoring using virtual ward platform technologies.

Introduction

In recent years, there has been growing attention to and investment in models of care that provide inpatient-level treatment and monitoring within the home setting. The first hospital at home service was introduced in NHSScotland in 2011, offering short-term, acute-level hospital care in an individual’s own home or home-like environment. This service delivery model has expanded considerably, and between April 2024 and March 2025, hospital at home services helped 15,811 people avoid hospital stays, easing pressure on Emergency Departments and the Scottish Ambulance Service.[15] This model of care is now well established in Scotland, with Healthcare Improvement Scotland providing support to optimise existing services, expand provision and develop new hospital at home pathways.

The virtual ward service delivery model is not the same as hospital at home. Unlike hospital at home, virtual wards do not involve healthcare staff routinely visiting patients at home. Instead, virtual wards rely on technology to monitor patients remotely. Patients may be referred to a virtual ward to avoid hospital admission (step-up care) or to enable earlier discharge from hospital while continuing to be monitored at home (step-down care). A range of virtual ward platform technologies is available, used alongside remote monitoring equipment to allow healthcare professionals to track patients’ vital signs and symptoms and escalate care when clinically necessary.

In NHSScotland, hospital at home and virtual wards are distinct service delivery models. However, the terms ‘hospital at home’ and ‘virtual wards’ are often used interchangeably in other countries, including NHS England and in the literature. To add further complexity, some hospital at home services in NHSScotland use virtual ward platform technology to supplement the physical care they provide.

A priority of the Scottish Government's Digital Health and Care Strategy is to ensure that digital options are increasingly available both for people accessing services and for the staff who deliver them.[16] Virtual wards have already been piloted or are currently operating in NHS Lanarkshire and NHS Borders. In 2026, NHS Greater Glasgow and Clyde announced plans to establish a large-scale virtual ward equivalent to 700 to 1,000 beds.[17]

We have been asked to evaluate virtual wards, which are supported by virtual ward platform technologies, to help determine whether further expansion and investment in this model of service delivery is warranted.

Research question

What is the clinical effectiveness, cost effectiveness, safety and patient experience associated with using virtual ward platform technologies to manage patients who would traditionally require inpatient monitoring, either to support transition to the home setting or to avoid hospital admission?

Literature search

A systematic search of the secondary literature was carried out between 10 and 15 September 2025 to identify systematic reviews, health technology assessments and other evidence-based reports. Medline, Embase and CINAHL databases were also searched for systematic reviews and meta-analyses.

The primary literature was systematically searched between 10 and 15 September 2025 using the following databases: Medline, Embase and CINAHL. Results were limited to English language publications.

Key websites were searched for guidelines, policy documents, clinical summaries, economic studies and ongoing trials.

Concepts used in all searches included virtual ward, virtual consultation, remote monitoring, hospital at home and admission avoidance. A full list of resources searched, and terms used is available on request.

Health technology description

The NHSScotland definition of a virtual ward is being used for this SHTG Recommendation. A virtual ward comprises several components that together form a complex intervention. A key feature of a virtual ward is the technology that enables patients to be safely monitored at home. Home monitoring might involve the use of remote monitoring devices, as well as telephone or video consultations with healthcare professionals. This SHTG Recommendation is specifically concerned with models that incorporate integrated virtual ward platform technologies. These models typically include a patient-facing app or website, medical devices for recording vital signs and a digital interface for healthcare professionals. Several virtual ward platform technologies are currently available for use across the NHS. NICE identified 11 technologies that were available for use in NHS England in 2023 and these are listed in *Appendix 2*.

Another defining feature of NHSScotland virtual wards is that patients have minimal face-to-face contact or in-person care from healthcare professionals. Regular consultations are still conducted, almost exclusively via telephone or online platforms, rather than in person. Patients' vital signs are measured either continuously or intermittently, using wearable devices or through self-monitoring. In some cases, patients or their carers are trained to take specific measurements and submit the data through an app or during a phone call.

Virtual wards require dedicated and appropriately trained staff to oversee patient monitoring and provide clinical support and cannot be managed as an additional responsibility by hospital-based staff. Virtual wards have established protocols to escalate care when a patient's vital signs indicate potential clinical deterioration.

Clinical effectiveness and safety

Overview

To inform the clinical effectiveness section, we have included an early value assessment and its accompanying evidence review published by NICE in 2023,[2] a high-quality systematic review by Shi *et al* (2024)[1] and six observational studies published after the Shi *et al* review.[3-8]

The evidence base remains at an early stage of development. Reviewing and synthesising the literature was complicated by the interchangeable and inconsistent use of the terms 'virtual ward' and 'hospital at home'. This made deciding which studies were eligible for inclusion challenging. Eligibility decisions were based on the models of service delivery outlined in each study, rather than the labels applied and on whether these models broadly conformed to the NHSScotland definition of a virtual ward.

The most frequently reported outcomes were hospital admissions, readmissions following discharge, length of stay and mortality. The patient populations most commonly included were those with upper respiratory conditions or unspecified acute illnesses that would traditionally require in-hospital monitoring. The body of evidence, while limited, suggested similar outcomes for patients managed in virtual wards compared with hospital wards.

The studies reported on outcomes related to an entire virtual ward model of service delivery, with the virtual ward platform technologies forming only one component of that model. As a result, the extent to which virtual ward platform technologies influence outcomes, relative to virtual ward models without such technologies, could not be evaluated.

Secondary evidence – clinical effectiveness and safety

NICE health technology evaluation on virtual ward platform technologies for people with acute respiratory infections[2]

Based on a comprehensive review of the evidence, NICE made the following recommendation:

Virtual ward platform technologies can be used in the NHS while more evidence is generated to monitor people over 16 with acute respiratory infection in their usual place of residence. They can be used for people who have been:

- referred for hospital admission or
- admitted to hospital and their condition is stable or improving but needs ongoing monitoring.

These technologies can only be used once they have appropriate regulatory approval, including Conformité Européenne (CE) mark, and Digital Technology Assessment Criteria (DTAC) approval.[2]

NICE also stated that virtual ward platform technologies should have the following key features:

- interoperability with electronic patient record systems and associated medical devices
- appropriate regulatory approval for associated medical devices (devices must also meet local testing standards and be validated for use in a place of residence)
- validated accuracy in people with black or brown skin for devices that measure oxygen saturation
- risk-stratified alerts (for example, red, amber or green) for healthcare professionals for when readings go outside of the agreed range (alerts can be based on device-measured vital signs or questionnaire responses)
- trend-based alerts (to increase specificity) if they are using continuous-monitoring wearable devices
- patient interface with an easy to use, user-centred design.[2]

While NHS England uses the term 'virtual ward' to describe what NHSScotland call 'hospital at home', the studies included by NICE appear to broadly meet the Scottish definition of 'virtual ward'. It is unclear how much face-to-face interaction patients received in each study, though this was likely minimal in most cases, as the majority of included patients had COVID-19.

The NICE recommendations were based on a comprehensive review of clinical, economic and safety evidence relating to virtual ward platform technologies.[13] The clinical evidence review included 19 studies involving a total of 6,129 participants. Of these studies, 16 were case series, 15 of which focused exclusively on patients with COVID-19. The remaining studies comprised two randomised controlled trials (RCTs) and one prospective cohort study. The RCTs were conducted in Denmark (57 patients with severe chronic obstructive pulmonary disease [COPD]) and the Netherlands (62 patients with COVID-19), while the UK-based cohort study included 318 patients with COVID-19.

The studies evaluated virtual wards to facilitate step-up care (one RCT and two case series), step-down care (one RCT and seven case series) or both step-up and step-down care (one cohort study and seven case series). All 19 studies evaluated technology-enabled remote monitoring that allowed patients to input data or capture data automatically, allowed medical staff to monitor patients at home, and 14 included an alert system.

The review authors concluded that the available evidence was insufficient to determine a treatment effect of virtual wards, primarily as a result of the limited amount of robust, and UK-based, comparative data. They also noted concerns about the generalisability of the evidence to UK patients with acute respiratory infections. This was because of heterogeneity across studies (particularly in terms of the healthcare settings, countries of evaluation, virtual ward admission criteria and outcomes reported) and because most studies focused exclusively on patients with COVID-19. The review authors also highlighted that patient comorbidities were poorly reported across the studies, making it difficult to assess how relevant the evidence base was to other clinical contexts.

The authors provided a narrative summary of the results (see *Table 1*) because the evidence base was not suitable for meta-analyses. Reported outcomes included length of stay, admissions, readmissions and escalation of care. The authors concluded that the body of evidence suggested no significant difference in outcomes for patients managed in virtual wards compared with hospital wards. There was no indication that virtual wards were unsafe and reported mortality rates were low. They concluded that virtual wards have the potential to be safe and may be an effective alternative to hospital wards for some patient groups. They also noted that the evidence base is at an early stage of development, and as such a ‘pragmatic view should be taken’ about the risk associated with virtual wards. Given the limitations of the evidence base, the review authors advise that the results need to be treated with caution.

NICE did not identify any evidence that compared one virtual ward platform technology with another.

Table 1: Summary of the NICE 2023 evidence synthesis on virtual ward technology platforms for people with acute respiratory infections

Outcome	Conclusion of evidence synthesis
Safety	Evidence on the safety of virtual wards was limited, although no studies suggested they were unsafe.
Mortality	Fifteen studies reported on mortality. Mortality on virtual wards was low, with very uncertain evidence that it might not differ to mortality in hospital wards or remote monitoring without a tech-enabled platform.
Length of stay	Fifteen studies reported virtual ward length of stay, ranging from 3.9 to 12 days. Only three compared virtual ward stays with hospital stays, and the findings were inconsistent, uncertain and none were UK-based.
Escalations, admissions and readmissions	Seventeen studies reported on escalations and readmissions, but comparisons were difficult because of inconsistent terminology and varying readmission locations (for example, hospital ward or critical care). Reported rates ranged from 2% to 22% for hospital admissions and 0.4% to 3.6% for critical care. Only three studies compared these outcomes between virtual and hospital wards, and the evidence was too weak to allow conclusions.
Infections	One case series (n=1,258) reported a five-fold reduction in infections in virtual wards, but lacked details on comparator data.
Patient contacts with other healthcare services	Evidence for the impact of virtual wards on patient contacts with other healthcare services was limited.
Acute respiratory infection resolution	No evidence was identified.

Systematic review by Shi *et al* 2024[1]

The systematic review by Shi *et al* is methodologically robust and well-reported.

The review authors acknowledged the ongoing confusion in terminology within the field, particularly the interchangeable use of 'hospital at home' and 'virtual wards'. To address, the authors used the umbrella term 'inpatient-level care at home' for evaluation purposes. Their review had two main objectives: first, to identify and describe the key components of models delivering inpatient-level care at home and second, to explore the evidence on the clinical and cost effectiveness associated with each of these components.

The review authors categorised models of inpatient-level care at home using a framework based on three core components:

1. **Clinical Activities**
   - *General inpatient-level care*: delivered by hospital or community-based health professionals, without involvement from allied health professionals.
   - *Extended multidisciplinary inpatient-level care*: includes additional services provided by allied health professionals, offering a broader scope of inpatient-level care.
2. **Workforce Configuration**
   - *Hospital **or** community-based health professionals:* single setting care provided by either hospital-based or community-based professionals.
   - *Hospital **and** community-based health professionals*: care delivered collaboratively by both hospital and community-based professionals.
3. **Technology Involvement**
   - *Low intensity*: use of basic communication tools such as telephone or teleconferencing.
   - *High intensity*: incorporation of advanced technologies including apps, wearables and digital medical devices.

Using this taxonomy, models of inpatient-level care at home which involve the use of virtual ward platform technologies would be classified as having *high-intensity technology involvement*.

The systematic review included 69 studies describing 63 interventions, which the review authors grouped into eight model types using the taxonomy they created. Of the studies, 38 were RCTs (n=6,413), generally assessed (using the Cochrane risk of bias tool) as having low or unclear risk of bias. The remaining 31 were non-randomised studies (n=31,950), most of which were judged to have serious or critical risk of bias. The primary conditions of the participants within the studies were mostly general unspecified acute medical conditions (24 studies), acute respiratory conditions (17 studies) and specific acute conditions (10 studies).

The key findings are summarised below.

- **Hospital readmission**: Six of the eight models, regardless of whether they used low-intensity or high-intensity technology, were associated with similar or reduced risk of hospital readmission compared with traditional inpatient care. This conclusion is based on low-certainty evidence from randomised trials. For the remaining two models, the evidence was either uncertain or unavailable.

- **Mortality**: For six of the models, evidence on mortality outcomes was either uncertain or unavailable. For two models, both with low-intensity technology involvement and involving hospital-based and community-based professionals, there was low-certainty or moderate-certainty evidence of similar or lower mortality than hospital-based inpatient care:
    - general inpatient-level care (relative risk [RR] 0.29, 95% confidence interval [CI] 0.09 to 0.95)
    - extended multidisciplinary inpatient-level care (RR 0.96, 95% CI 0.79 to 1.16).
- **Length of care stay:** One of the models with low-intensity technology involvement suggested a longer length of stay, on average, compared with hospital-based inpatient care (mean difference 4.85 days, 95% CI 1.8 to 7.9). Three of the models had average lengths of stay that were similar or less than hospital-based inpatient care. The remaining four models had unavailable or uncertain evidence.
- **Cost effectiveness**: Evidence on cost effectiveness was lacking for high technology-enabled models. However, available data suggest that low technology-enabled multidisciplinary care, delivered by hospital-based teams, may be more cost effective than standard inpatient care for patients with COPD exacerbations.

These findings are summarised in *Table 2*.

The authors found no evidence of a difference in hospital readmission rates between technology-enabled home care and inpatient care, but the evidence was of low certainty. Likewise, the limited mortality data suggests no difference in patient survival between these models of care. It remains uncertain whether incorporating high-intensity technology (including virtual ward platform technologies) into inpatient-level care at home offers additional benefits over the low-intensity technology models.

Table 2: Summary of conclusions for eight models of inpatient care at home, adapted from Shi et al[1]

Inpatient-level care at home model component			Outcomes		
Clinical activities	**Workforce**	**Technology involvement**	**Mortality**	**Hospital readmission**	**Length of care stay in days**
General inpatient-level care	Hospital or community-based professionals	Low intensity	Uncertain evidence	No difference (low-certainty RCT evidence)	No difference (low-certainty RCT evidence)
		High intensity	Uncertain evidence	Uncertain evidence	Uncertain evidence
	Hospital and community-based professionals	Low intensity	Lower mortality incidence on average than hospital-based inpatient care (low-certainty evidence)	Lower readmission incidence on average than hospital-based inpatient care (low-certainty RCT evidence)	No evidence available
		High intensity	Uncertain evidence	Lower readmission incidence on average than hospital-based inpatient care (low-certainty non-RCT evidence)	No evidence available
Extended multidisciplinary inpatient-level care	Hospital or community-based professionals	Low intensity	Uncertain evidence	No difference (low-certainty RCT evidence)	Shorter stay on average (2.9 days less) than hospital-based inpatient care (low-certainty RCT evidence)
		High intensity	No evidence available	Lower readmission incidence on average than hospital-based inpatient care (low-certainty non-RCT evidence)	No difference (low-certainty RCT evidence)
	Hospital and community-based professionals	Low intensity	No difference (moderate-certainty RCT evidence)	No difference (low-certainty RCT evidence)	Longer stay on average (4.85 days more) than hospital-based inpatient care (low-certainty RCT evidence)
		High intensity	No evidence available	No evidence available	No evidence available

Primary studies – clinical effectiveness and safety

We identified six additional primary studies, which were published after the NICE guidance and the review by Shi *et al*.[3-8] Five were observational in design and varied in quality.[3-7] One was a mixed-methods evaluation.[8]

The five observational studies were conducted within NHS England, where the term 'virtual ward' is frequently used interchangeably with 'hospital at home'. Based on the authors' descriptions of the models evaluated, these services broadly align with the definition of a virtual ward used in the NHSScotland context and applied in this SHTG Recommendation. The sixth study evaluated a 'virtual hospital in the home' model in Australia, and its description similarly aligns with our working definition of a virtual ward.

None of the studies were focused specifically on evaluating the virtual ward platform technologies. The studies have been included as they have described the use of these technologies as part of a virtual ward model. However, they do not allow us to determine whether these technologies offer advantages over models using less or different technology, or which specific components may be associated with improved outcomes.

Given the heterogeneity between the studies, each study has been described narratively below and all are summarised in *Table 4*.

A virtual ward for patients with acute heart failure[7]

A well-designed cohort study by Sankaranarayanan et al (2024) compared outcomes for patients with acute heart failure who were managed and monitored in a virtual ward with those admitted to a hospital ward.[7] To account for potential differences in baseline characteristics between the virtual ward group and the hospitalised group, the researchers applied propensity score matching (a statistical method that pairs patients from different groups who have similar characteristics to make the groups more comparable). Clinical outcomes (rehospitalisations and mortality) were compared between the groups at 1, 3, 6 and 12 months.

The study included adult patients with acute decompensated heart failure, a sudden worsening of heart failure symptoms caused by fluid build-up that usually requires intravenous diuretics. The intervention group included 554 patients managed on a virtual ward (average age 73.1 years, 46% female), and the comparator group included 404 patients managed in hospital (average age 74.2 years, 49% female).

Patients were monitored using the DOC@HOME® virtual ward platform and provided with smart devices and equipment to monitor blood pressure, pulse, oxygen saturation, single lead electrocardiogram and step count. They completed a daily symptom questionnaire and received a daily telehealth nurse call. Face-to-face reviews occurred when intravenous diuretics were used. A heart failure specialist nurse was available from 8am to 8pm daily, and a consultant cardiologist conducted a daily virtual ward round.

The authors reported that rehospitalisations and mortality were significantly lower in the group of patients monitored on the virtual ward at 1, 3, 6 and 12 months. In addition, multivariate logistic regression analysis indicated that, compared with patients monitored in hospital, those on a virtual ward had lower odds of readmission and mortality (*Table 3*).

Table 3: Clinical outcomes of heart failure patients treated on virtual wards compared with hospital wards, taken from Sankaranarayanan et al (2024)

Clinical outcome		1 month	3 months	6 months	12 months
Rehospitalisations	Virtual	8.6%	21%	28%	47%
	Hospital	21.5%	30%	41%	57%
	p-value of mean difference	p<0.001	P=0.003	p<0.001	p=0.005
	Odds ratio (95% CI, p-value)	0.3 (0.2 to 0.5, p<0.0001)	0.15 (0.1 to 0.3, p<0.0001)	0.35 (0.2 to 0.6, p=0.0002)	0.25 (0.15 to 0.4, p≤0.001)
Mortality	Virtual	5%	9.5%	15%	20%
	Hospital	13.7%	15%	21%	26%
	p-value of mean difference	p<0.001	p=0.001	p=0.03	p=0.04
	Odds ratio (95% CI, p-value)	0.26 (0.14 to 0.48, p<0.0001)	0.11 (0.04 to 0.27, p<0.0001)	0.35 (0.2 to 0.61, p=0.0002)	0.6 (0.48 to 0.73, p≤0.03)

The authors reported that higher scores on measures such as the Get With The Guidelines–Heart Failure (GWTG-HF) scale and clinical frailty scores were associated with increased odds of rehospitalisation and mortality at all time points for both groups. In contrast, a higher daily step count among patients on a virtual ward was associated with lower odds of rehospitalisation at 1 and 3 months, and reduced mortality at 1 month.

Based on these findings, the authors suggested that virtual wards could provide a safe and effective alternative to inpatient monitoring for appropriately selected patients with acute decompensated heart failure. They proposed that in deciding which patients might be suitable for the virtual ward, consideration is given to various clinical risk scores which may predict adverse outcomes. They also highlighted that daily step count may serve as a useful indicator for predicting short-term adverse clinical outcomes in this group.

A virtual ward for people with atrial fibrillation[6]

An NHS England pilot by Saleh et al (2024) evaluated a virtual ward for patients with new or recent atrial fibrillation, using the FibriCheck® app on patients' smartphones integrated with Patients Know

Best®, a secure web-based platform. Patients were either offered onboarding to the virtual ward as outpatients to avoid admission to hospital (step-up care), or on discharge following hospitalisation (step-down care).

Patients used FibriCheck® twice daily, which employs smartphone photoplethysmography (a light-based method to measure blood flow changes at the surface of the skin) and camera functions to measure heart rate and rhythm. Data were uploaded via Patients Know Best® for review by a central monitoring hub staffed by nurses and allied health professionals. A traffic light system guided frequency of telephone assessments by the healthcare team, with red flag symptoms prompting urgent care escalation.

Among 73 patients (mean age 65, 45% female) monitored for 1 to 2 weeks, 53% required urgent escalation: 23% were advised to attend the emergency department, 26% attended for expedited reviews and 36% required medication changes. By 3 months, 4% reattended the emergency department. Virtual ward patients had hospital stays about 3 days shorter than before virtual ward implementation. The authors concluded that approximately 22 arrhythmia-related readmissions were prevented by the virtual ward.

The Wrightington, Wigan and Leigh NHS Trust virtual ward[4, 5]

Two studies, by different authors, reported on apparently the same virtual ward service from one NHS Trust, which was enabled using the Current Health® platform (no longer available in the UK).[4, 5] The service supported step-up and step-down care, with referrals from ambulatory care, primary care and inpatient settings. Patients managed on the virtual ward received a home hub that automatically transmitted data from remote monitoring devices, along with the devices themselves and a tablet for completing symptom surveys and communicating with healthcare professionals.

The most recent study, by Pugmire et al (2025), was retrospective, and reported on data from 1,835 admissions to the service.[5] The authors reported that 38% were step-up referrals (31% ambulatory, 7% primary care) and 62% were step-down (inpatients). Most referrals were from thoracic and acute medicine (77%). Across both groups median virtual ward stay was 8 days (interquartile range 5 to 13). Escalations included 12% to hospital (n=209), 11% to emergency department out-of-hours (n=179) and 2% to urgent medical services (n=29). Device use rate was 92%, with 38 minor safety incidents.

The second study, by Jalilian et al (2024), focused on step-down patients only, and compared the length of stay and economic impact between virtual ward and hospital patients (the economics element is discussed in the cost-effectiveness section). Virtual ward patients (n=318) were matched to hospital patients (n=350). Length of stay was measured from hospital admission to discharge (hospital patients) or to virtual ward enrolment (virtual ward patients).

Virtual ward patients had a shorter in-hospital stay than the hospital patients (2.89 versus 5.96 days, $p<0.001$). They showed better survival at follow-up (86.5% versus 72.4%, $p<0.05$) but higher 6-month readmission rates (40.3% versus 30.9%, $p<0.05$) and greater mortality if readmitted (hazard ratio 3.18 versus 2.76).

A surgical virtual ward for selected stable postoperative patients[3]

This preliminary observational study, by Cheng et al (2025), evaluated a surgical virtual ward in an NHS England centre. It was designed to enable early discharge of selected stable postoperative patients through remote monitoring, with data transmitted to a central hub and scheduled virtual consultations (the technology used was not otherwise described). From January 2024 to February 2025, 46 patients (mean age 59.8 years, 54% male) were enrolled. At 30-day follow-up, no patients were readmitted and no deaths were reported, suggesting promising early outcomes. The small sample size and the preliminary, descriptive design of this study preclude any conclusions other than the need for continued data collection.

A virtual ward for people with COVID-19 in Australia[8]

Vo et al (2025) reported a mixed-methods evaluation of a 'virtual hospital in the home' service established during the COVID-19 pandemic to support adults, maternity patients and children with moderate COVID-19 symptoms alongside other health needs.[8] The evaluation drew on qualitative and quantitative data collected from patient medical records, patient surveys and interviews with staff and patients. In total, 3,192 patients were enrolled to the service. Patients were provided with devices such as oximeters and thermometers according to clinical need, while sphygmomanometers were supplied only to the maternity patients. Patients were required to upload their observations to a web-based coordination system (no other details given), which nurses reviewed daily for signs of deterioration. Individuals whose symptoms worsened, or who required antiviral treatment or pathology tests, were transferred to a hospital-based treatment room for in-person assessment.

No deaths were reported. Patients reported valuing continuous access to care and described experiencing improved recovery at home. Staff considered the model effective for identifying and managing high-risk patients in the community and noted its contribution to reducing pressure on hospital beds. Implementation challenges arose from the urgency of the pandemic response, constrained infrastructure and workforce capacity, and evolving COVID-19-related requirements. These were partially mitigated by key 'people factors', including strong consultant leadership, staff commitment and adaptability. The service was estimated to have prevented 16,651 inpatient bed days. The authors concluded that the virtual ward model was safe and effective, and noted that integrating such a service into routine care would require adequate resource planning, a skilled multidisciplinary workforce, clearly defined care pathways and equity-focused strategies.

Table 4: Summary of primary studies

Study	Study design	Patient population	Virtual ward platform technology	Main outcomes	Results
Sankaranarayanan et al (2024)[7] England	Retrospective cohort study Virtual ward (n=554) versus in hospital (n=404)	Patients with acute heart failure	DOC@HOME®	Readmissions Mortality	The authors reported that readmissions and mortality were significantly lower in the group of patients monitored on the virtual ward at 1, 3, 6 and 12 months. In addition, multivariate logistic regression analysis indicated that, compared with patients monitored in hospital, those on a virtual ward had lower odds of readmissions and mortality.
Saleh et al (2024)[6] England	Evaluation of NHS England pilot n=73	Patients with new or recent atrial fibrillation	FibriCheck®	Escalations Readmissions Length of stay	Among the patients, monitored for 1 to 2 weeks, 53% required urgent escalation: 23% were advised to attend the emergency department, 26% attended for expedited reviews and 36% required medication changes. By 3 months, 4% reattended the emergency department. Virtual ward patients had hospital stays about 3 days shorter than before virtual ward implementation.
Pugmire et al (2025)[5] England	Retrospective review of a virtual ward service n=1,835	Various, mostly from thoracic and acute medicine (77%)	Current Health®	Escalations Length of stay Device adherence Safety	38% were step-up referrals (31% ambulatory, 7% primary care) and 62% were step-down (inpatients). Escalations included 12% to hospital (n=209), 11% to emergency department out-of-hours (n=179) and 2% to urgent medical services (n=29). Across both groups median virtual ward stay was 8 days (interquartile range 5 to 13). Device adherence was 92%, with 38 minor safety incidents.
Jalilian et al (2024)[4] England	Retrospective cohort study Virtual ward (n=328) versus in hospital (n=350)	Various	Current Health®	Length of stay Survival at follow-up 6-month readmission rates Mortality	Virtual ward patients had a shorter in-hospital stay than the hospital patients (2.89 versus 5.96 days, p<0.001). They showed better survival at follow-up (86.5% versus 72.4%, p<0.05) but higher 6-month readmission rates (40.3% versus 30.9%, p<0.05) and greater mortality if readmitted (hazard ratio 3.18 versus 2.76).
Cheng et al (2025)[3] England	Evaluation of a surgical virtual ward n=46	Selected stable postoperative patients	*Not described*	Readmissions Mortality	At 30-day follow-up, there were no readmissions or deaths.
Vo et al (2025)[8] Australia	Mixed-methods evaluation n=3,192	Patients with COVID-19	*Not described*	Mortality Patient and staff perspectives Bed days prevented	No deaths were reported, and both patients and staff viewed the virtual ward as supporting safe recovery at home and reducing hospital pressure. Despite pandemic-related implementation challenges, strong leadership and adaptable staff helped mitigate issues. The model was deemed safe and effective, though routine use would require adequate resources, skilled staffing and clear pathways.

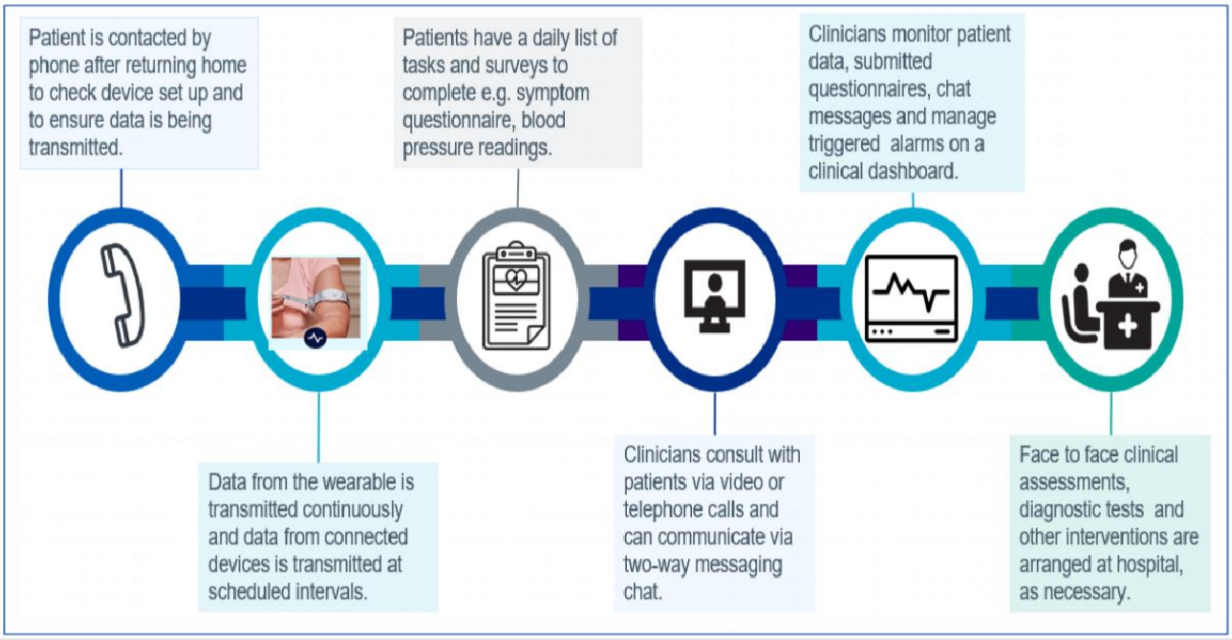
Case study from NHSScotland

NHS Borders respiratory virtual ward

In January 2024, NHS Borders received fixed-term funding from the Scottish Government to increase virtual bed capacity within the board.[18] The respiratory team set up a virtual ward, building on the lessons learned from previous tests of change. Given the small size of the team and the absence of a community respiratory service, there was limited capacity to absorb the additional workload associated with the virtual ward. The short-term nature of the funding required reliance on locum staff to support consultant and trainee roles. The respiratory virtual ward operated from 22 January to 31 March 2024, during which time there were 52 admissions involving 50 patients (24 male and 26 female). The median patient age was 62 years, with ages ranging from 18 to 84.[18]

Thirty-six patients (69%) were monitored on the respiratory virtual ward as part of an early supported discharge from hospital, while the remaining 16 patients (31%) avoided hospital admission altogether. Median length of stay was 5 days (range 3 to 17). Seven respiratory pathways were supported (asthma, bronchiectasis, chronic obstructive pulmonary disease, COVID-19, interstitial lung disease, pneumonia and pulmonary thromboembolic disease), although no patients were managed with a primary diagnosis of COVID-19 in the 10-week period when the virtual ward was operational. Patients were provided with kits (Current Health® – no longer available in the UK market) which included a home connectivity hub, a wearable device that continuously monitored heart rate, oxygen saturation, skin temperature, respiratory rate and step count, along with an Android tablet and charging dock. Data was monitored on a clinical dashboard (Current Health®) from which the clinical team could manage alarms triggered, undertake video consultations, communicate with patients via two-way messaging and record clinical notes. All patients had at least one virtual consultation daily. The patient monitoring process on the virtual respiratory ward is summarised in *Figure 1*.[18]

Figure 1: Respiratory virtual ward patient monitoring



An evaluation of the respiratory virtual ward reported that:

- Out of 433 patient consultations, 371 (86%) were carried out virtually (video or telephone) and 62 (14%) were completed face-to-face.
- Seventy consultations (34%) took place outside official virtual ward hours, mainly to help patients set up their monitoring kits after discharge or to respond to concerning clinical data or triggered alarms. This resulted in members of the clinical team regularly working additional unpaid hours to provide patient support.
- Seven patients were admitted to hospital from the respiratory virtual ward. The clinical team arranged direct admission for three patients outside virtual ward operating hours. Three patients were admitted after face-to-face clinical assessment in ambulatory care. One patient self-escalated via the out-of-hours service.
- An estimated 236 occupied in-hospital bed days were prevented. The number of days monitored in the virtual ward does not necessarily equate to the number of occupied bed days prevented.
- Continuous monitoring was required for safely managing higher-acuity patients at home. Unlike intermittent monitoring, where patients record their own observations at set times, continuous wearable devices provided real-time data, allowing early detection of deterioration and timely clinical review or readmission.
- Managing patients in the respiratory virtual ward saved an estimated 6,484 kgCO_2 (kilogrammes of carbon dioxide), even with some hospital visits for assessments and equipment return. This is roughly equivalent to 2.5 return flights from London to New York.

- Feedback was received from 42 patients (84%), all of whom felt safe and knew how to get help. They appreciated being monitored at home, found regular contact with the clinical team reassuring and responded positively to the remote monitoring technology.
- Staff feedback was positive, highlighting that patients gained more control over their condition and returned to normal activities sooner. Staff found the monitoring kits and clinical dashboard easy to use, though noted patients often needed help setting up the kits at home, especially in the evenings.[18]

The evaluation report stated that the virtual ward lacked resilience, with a heavy reliance on high-cost locum staff to cover medical roles. The report indicated that a longer-term service model would be expected to differ from this small-scale test of change and, in particular, would not be dependent on locum staff. In addition, the report noted that the ward's limited operating hours were a challenge, recommending future services run at least 12 hours a day, 7 days a week.

Patient and social aspects

The NICE early value assessment reported high levels of sustained use and acceptability of virtual ward technologies among patients. Barriers such as digital literacy, technical issues, inadequate training, language challenges and digital exclusion were reported.[13]

NICE detailed the benefits and limitations of virtual wards from the patients' perspective, and these largely mirrored those of hospital at home models of care. As well as expanding options for patients, benefits included greater comfort, freedom, access to fresh air and interaction with loved ones, as well as reduced risks of deconditioning and hospital-acquired infections.[2]

Virtual wards are not suitable for everyone. NICE stressed the need to assess home environments, including access to utilities and meals, and acknowledged that some people may prefer hospital care, particularly if they do not like using digital technologies. Reported challenges included a lack of a fixed address, limited space or privacy, caregiver burden and considerations around frailty, cognitive or learning disabilities.[2] While remote monitoring can offer reassurance to some, it may cause anxiety for others. For some individuals, loneliness may be a concern, and managing an illness at home could feel overwhelming.

We also identified two systematic reviews[11, 14] and a small qualitative study,[12] both published after the NICE review. They reiterated the themes discussed by NICE, with one review (Cucurachi et al, 2025) highlighting that some of the main barriers patients and caregivers face on virtual wards are related to limited technological knowledge, medical literacy and language barriers, and emphasised the need for mandatory training to address these issues.[11] Similarly, the second review (Pahirden et al, 2025) concluded that barriers included cultural and communication mismatches, inadequate housing, lack of caregiving support, digital exclusion among older adults and reduced benefit or engagement for those with complex health needs.[14] They noted that targeted interventions are needed for equitable implementation across the UK.

The qualitative study by Lyndon et al (2025) involved semi-structured interviews with 14 patients and 16 clinicians to explore their views on participating in virtual wards in Cornwall.[12] Patients valued the virtual ward as a credible alternative to hospital admission, frequently highlighting the compassion and professionalism of staff, which made them feel safe and supported at home. With technology-enabled remote care, patients most commonly spoke about the importance of the virtual interactions with clinicians. Some patients found the remote monitoring equipment easy to use and valued features like instant messaging. The authors also reported instances of digital anxiety and exclusion. Certain patients struggled with the technology and wearable devices because of reduced dexterity, memory issues or complexity. For some, the volume of technology was 'daunting'. Similarly to NICE and the systematic reviews, barriers to digital inclusion included limited access to devices, low digital literacy and challenges related to language, age and cultural background.

Equality issues

With virtual wards, there is a risk of disproportionately excluding people within some groups such as older adults, people experiencing homelessness, those with low incomes or unemployment, individuals with disabilities and those in areas lacking service access.[19]

NICE highlighted the need for additional support and resources for individuals who are unfamiliar with digital technologies, lack access to smart devices or the internet, or face barriers such as visual or hearing impairments, limited manual dexterity or difficulty reading or understanding English.[2]

Some pulse oximeters have been shown to overestimate oxygen saturation in people with black and brown skin, presenting an important safety concern. NICE recommends that devices used in virtual wards be tested and validated in patients with a range of different skin tones, and that clinical decisions be informed by multiple measures, not a single parameter.[2]

Patient group submission

To support this Recommendation, we received a patient group submission from the Roy Castle Lung Cancer Foundation, a charity that provides information and support to people affected by lung cancer and their loved ones. The submission drew on insights shared within online patient forums about experiences following lung cancer surgery. It included three accounts from individuals who had used virtual wards after lung cancer surgery, although these services may not have fully aligned with the NHSScotland definition of a virtual ward.

For patients recovering from lung cancer surgery, home monitoring (compared with no monitoring) was perceived as offering reassurance, reducing feelings of isolation and providing a positive emotional impact. The submission also indicated that patients would welcome technologies that help prevent readmissions or enable the early identification and prompt management of complications, such as wound infections. For people without a support network at home, knowing their condition was being monitored daily, and that they had someone they could speak to if concerns arose, increased their confidence in managing at home after surgery. The submission acknowledged that this type of service may not be equally accessible to all groups, including people experiencing homelessness, older adults and those living in rural areas.

The accounts from the three individuals who had experienced home monitoring (not in Scotland) following lung cancer surgery varied. While they described the service positively in some respects, they also reported challenges, including not receiving appropriate equipment and experiencing poor communication with staff.

Public perception

In a survey of 7,100 nationally representative members of the British public aged 16 and over, 78% said they would be happy to monitor their own health at home using technology instead of going to hospital, while only 13% said they would not.[20] The authors noted less support from the public when the term 'virtual ward' was used. Further, what the authors described as a virtual ward was what NHSScotland would call hospital at home. This suggests a potential need to either adopt alternative terminology or ensure that everyone understands the terminology that is being used in a particular context.

Survey of Scottish public, October–November 2025

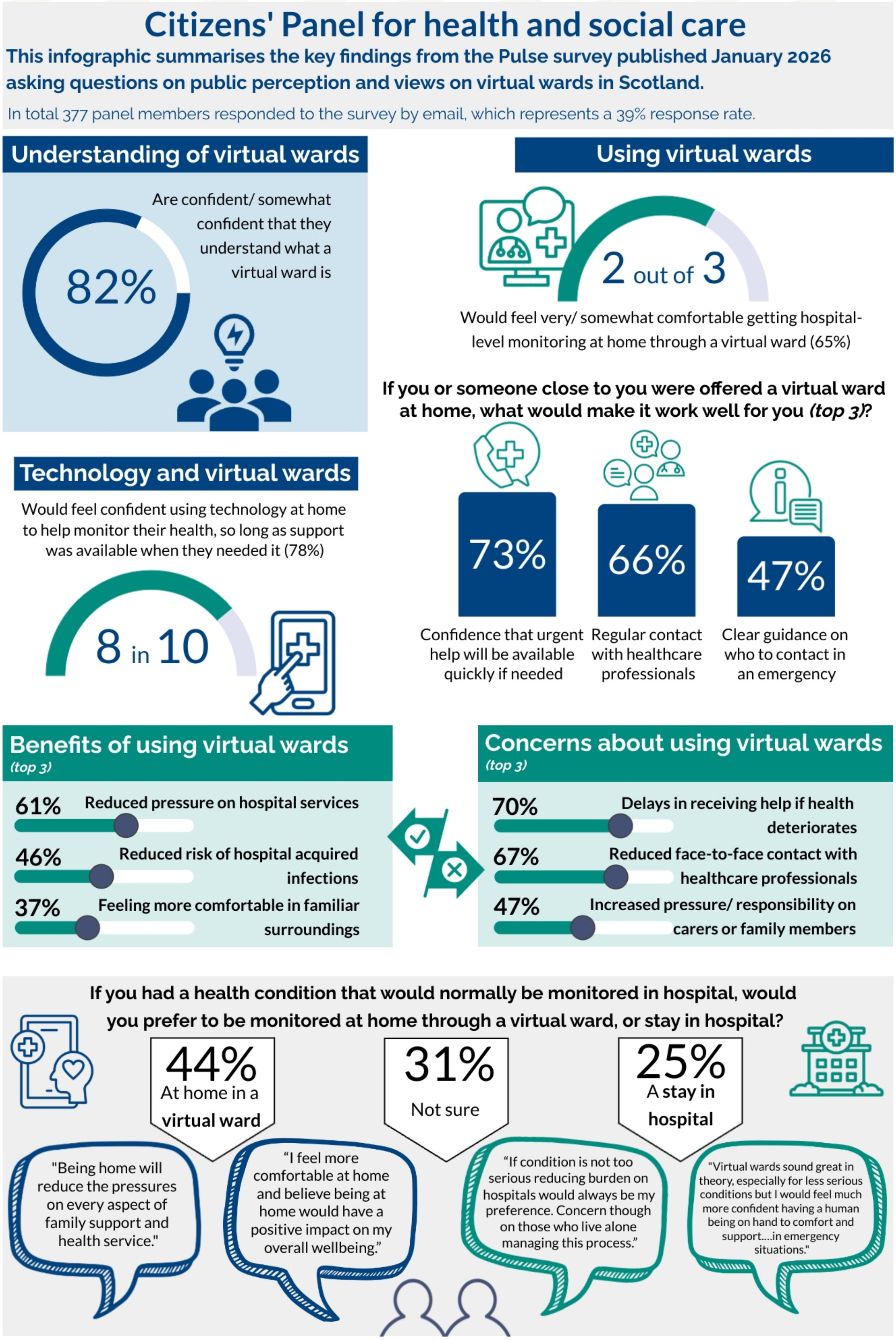
To inform this SHTG Recommendation, we obtained public views on virtual wards through a Citizens' Panel survey, coordinated by the Community Engagement and Transformational Change Directorate at Healthcare Improvement Scotland. The Panel provides insight from a representative sample of the Scottish population, with active participants from across all 32 local authority areas.

The virtual wards survey was sent electronically to 963 Citizens' Panel members in autumn 2025 and 377 responses were received (a response rate of 39%). This is sufficient to support robust analysis with overall results accurate to ± 5.05% (based on a 50% estimate at the 95% level of confidence). The results of the survey are summarised in *Figure 2*, and the full report is available from *TO BE ADDED*

The survey found that, if given a choice, 44% of respondents would prefer home monitoring via a virtual ward, 25% would prefer an in-hospital stay and 31% were unsure. When asked to explain their preference, the most common theme across all three groups was that their choice would depend on the health condition being treated.

Respondents who favoured virtual wards valued the comfort and independence of being at home, provided hospital-level oversight was assured. Those preferring an in-hospital stay emphasised safety, immediate access to staff and reassurance from in-person monitoring. Respondents who were unsure most often said their decision would depend on the condition being treated and their confidence in the reliability of virtual ward support.

Figure 1: Infographic of the Citizens' Panel survey on virtual wards



Organisational issues – factors affecting implementation

A 2025 systematic review of qualitative studies by Cucarachi et al synthesised findings from 16 studies, reflecting the views of 149 healthcare professionals including obstetricians, midwives, nurse clinicians, general practitioners, physiotherapists, occupational therapists, pharmacists, residents, community matrons and psychiatrists.[11]

The review explored factors affecting the adoption of virtual wards. Across the included studies, healthcare professionals identified several key factors that supported successful implementation:

- skilled and specialised staff with the capability to work remotely, build patient rapport and use digital technologies effectively
- clear and consistent criteria and protocols for patient admission, care delivery and discharge
- adequate resources, including reliable technology and equipment, sufficient staffing and sustainable funding
- strong leadership and active engagement from senior executives, particularly in promoting effective communication among healthcare teams
- positive peer attitudes towards virtual wards, which helped foster wider acceptance and uptake.[11]

The NICE early value assessment also highlighted that clinical experts and companies stated that a key barrier to implementation was interoperability of the virtual ward platforms with electronic patient records.[2] They highlighted the importance of information being accessible to the people who need it, including the multidisciplinary team running the wards and any out-of-hours services providing support.

Cost effectiveness

The evidence base on the cost effectiveness of virtual wards, compared with inpatient monitoring or non-technology-enabled models of home monitoring, remains limited, although it is evolving. To inform this section, a cost-comparison model developed for the NICE early value assessment was included,[2] alongside two cost-comparison studies based on observational data from virtual wards in NHS Trusts in England, as described in the clinical effectiveness section.[4, 9] An additional cost-comparison study evaluating a COVID-19 virtual ward at Leicester Hospitals NHS Trust was also identified.[10]

NICE health technology evaluation on virtual ward platform technologies for people with acute respiratory infections[2]

NICE developed a simple cost-comparison model as part of their early value assessment of virtual ward platforms for acute respiratory infections.[2] The modelling suggested that the incorporation of virtual wards into the NHS could potentially be cost saving by £872 per patient when compared with an inpatient stay, and by £115 per patient when compared with care at home without a technology-enabled virtual ward. When expressed in terms of equivalent hospital bed day costs saved, the average length of stay of 8.89 days in a virtual ward was equivalent to 2.89 hospital bed days. In other words, cost savings could be achieved if a patient was to leave hospital 3 days earlier and stay in a virtual ward for just under 9 days.

The model was platform agnostic and compared costs associated with set-up, equipment, staff time, monitoring, outpatient appointments and subsequent hospital admissions over a 30-day time horizon. It was also assumed that all comparators were equally effective and that training, implementation and treatment costs per person were directly scalable to any virtual ward size.

Despite illustrating the cost-saving potential of virtual wards, there are many areas of uncertainty impacting on the validity of the model results. Key areas of uncertainty are the inability to capture differences in safety outcomes, lack of implementation costs, variations in different features of a virtual ward platform which may or may not impact effectiveness, variations in clinical practice and the point at which step-down care from inpatient stay to virtual ward is initiated.[13]

A virtual ward for patients with acute heart failure

An analysis by Rasoul et al (2025) compared the cost of a specialist acute heart failure virtual ward (HFVW) in Liverpool to standard hospital inpatient care.[9] The analysis included direct costs incurred by the virtual ward as well as additional costs across the care pathway related to the intervention.

Six months' data for 648 patients monitored on the HFVW were extrapolated across a full year to encompass the costs and resource use associated with all patients monitored on the virtual ward. For each patient monitored on the HFVW, costs and resource use were calculated over 30 days from discharge.

Standard care inputs were sourced from a control group of patients who were admitted to an acute inpatient bed with the primary diagnosis of heart failure. The control group was propensity matched on a 1:1 ratio based on age, gender and primary diagnosis by ICD-10.

The base case results showed that the HFVW pathway was cost saving compared with standard care with an incremental cost saving of £1,135 per patient per episode (PPPE) in the first year, based on an average HFVW occupancy rate of 88%. Net cost savings persist even after accounting for initial one-time set-up expenses and ongoing costs.

The net cost benefit of HFVW was driven by a marked reduction in-hospital stay costs. This was a result of shorter length of stay facilitated by early supported discharge, a significant decrease in the number of re-attendances to emergency departments and a reduction in hospital readmissions within 30 days

The total cost included virtual ward set-up cost, annual running costs, patient set-up costs, monitoring costs, appointment costs, point-of-care tests and home intravenous therapy delivery, admission costs (step-up patients), and the cost savings from the reduced length of stay in hospital (step-down patients).

The model also predicted greater levels of net cost benefit with increased capacity and higher throughput in the HFVW pathway. Threshold analysis indicated that the break-even point (where the costs of virtual ward and standard care are equal) was achieved even with only 185 patients entering the virtual ward annually.

The authors concluded that the Liverpool HFVW has been cost effective when the savings are viewed alongside concurrent evidence regarding the beneficial clinical outcomes achieved by HFVWs in terms of reduced readmissions and mortality.[7]

The Wrightington, Wigan and Leigh NHS Trust virtual ward[4]

A retrospective longitudinal study at the Wrightington, Wigan and Leigh Teaching Hospitals Foundation Trust evaluated the length of stay difference and its economic implications between hospital patients and virtual ward patients. Results of the length of stay, readmission and survival models can be found in the clinical effectiveness section.[4]

Virtual ward patients were matched manually with patients admitted exclusively to the hospital, resulting in 350 virtual ward hospital pairs. Matching characteristics were sex, age, primary diagnosis description and clinical frailty score. The primary diagnosis description for the majority (64.3%) of the matched patients corresponded to pneumonia, COPD, COVID-19, atrial fibrillation or heart failure.

The total costs for the 40-bed virtual ward during the calendar year 2022 was around £1.05 million. There were additional non-recurring costs of £100,000 as part of the process of setting up the service. The calculated reduction of inpatient hospital bed days was 3.07 days for each of the patients monitored on the virtual ward. Considering this cost was based on 366 virtual ward patients, this equated to 1,123.62 hospital bed days freed in a year.

The cost of saving one inpatient hospital day was £935. If the patient had stayed in the hospital rather than being monitored on the virtual ward, the equivalent inpatient hospital day cost would have been £536. Therefore, the cost of virtual ward care is approximately three quarters higher than that of traditional inpatient care. The higher cost was a result of only 24% of the overall capacity of the virtual ward being utilised. Sensitivity analyses showed that increasing the uptake of virtual ward beds and reducing the time from hospital admission to virtual ward admission could reduce the cost of a freed inpatient bed day.

The authors concluded that given the current virtual ward organisation, it was unlikely that the virtual ward model would be more cost effective than traditional inpatient management.

An economic evaluation of a COVID-19 virtual ward service

An economic evaluation of a COVID-19 virtual ward service evaluation at the Leicester Hospitals NHS Trust reported estimated health care system savings of 1,103 bed days and £529,719 in net financial savings across two key groups of patients.[10]

Results were based on observational data from 310 patients admitted to hospital with COVID-19 and discharged into the virtual ward to either aid with oxygen weaning in their own home or discharged early to recover more fully at home and free up beds. The virtual ward platform used was CliniTouch Vie® (Spirit Health). Comparator data were sourced from two NHS datasets on COVID-19 hospital activity from March 2020 to March 2022.

The cost of an average stay in the virtual ward (£184.38) was 34.7% of the cost of a bed day (£532). The costs of the intervention were 9.7% of the estimated gross savings and the mean net saving per patient was £1,709 in the base case without including the savings associated with a likely reduction in readmissions. The 30-day readmission rate was 2.9%, which was substantially beneath alternative comparative data.

In the sensitivity analysis, the parameter with the biggest influence was the acute length of stay. The greatest area of uncertainty was the saving in bed days in patients who were not on oxygen prior to their discharge into the virtual ward.

Overall, confident conclusions regarding the cost effectiveness of virtual ward models of service delivery are not currently possible. The number of available economic analyses is limited. Collectively, these studies suggest that virtual wards may enable more efficient use of resources, driven by earlier hospital discharge and lower readmission rates. The magnitude of any resulting savings is expected to vary across settings. This reflects differences in the features and functionality of virtual ward technologies, as well as the extent to which virtual wards can be operated at or near capacity.

Conclusion

Virtual wards have the potential to meet the growing demand for inpatient-level monitoring, while allowing people to remain in the comfort of their own homes. The available evidence is limited and heterogeneous (particularly in terms of the components of the virtual ward model, healthcare settings, countries of evaluation and virtual ward admission criteria) but suggests that virtual wards can deliver comparable outcomes to monitoring within a hospital ward for selected patient groups. The benefits for patients are similar to those seen in hospital at home models and relate to the comfort of being in a familiar environment and close to loved ones. For some individuals, the technology may be inaccessible or difficult to use, and they may feel safer and more supported within a traditional hospital setting.

Our research question was focused specifically on the contribution of virtual ward platform technologies within the broader virtual ward model of service delivery. The current evidence base does not allow us to determine the added value of these technologies compared with models that do not use them, nor to identify which specific technology features might drive improved outcomes. In a report by the McGill University Health Centre (Canada), the authors emphasise that rather than prioritising the latest innovations in virtual ward technology, it is more important to first assess the needs of stakeholders and the programme itself, and then ensure that the chosen technology aligns with those requirements.[21]

Our evidence synthesis also highlighted barriers to implementation such as staffing, digital exclusion and interoperability with existing systems. These would need to be addressed to ensure equitable and sustainable service delivery.

Given these findings, a cautious approach is recommended. Further investment in virtual ward platform technologies, and on virtual wards generally, should be accompanied by robust evaluation frameworks to generate data on clinical effectiveness, safety, cost and patient experience. In addition, virtual ward models should not be viewed as a single, uniform healthcare solution. Instead, it is important to evaluate how individual components within these models influence patient outcomes in different patient groups. This approach will support more robust and evidence-based decisions about how virtual ward models are scaled across NHSScotland and ensure that they are tailored to the needs of individual services.

Identified research gaps

Similarly to the 2023 NICE health technology evaluation, we identified several key evidence gaps for virtual ward platform technologies, including:

- a lack of comparative studies within an NHS setting, which limits firm conclusions regarding clinical effectiveness and safety, and any economic modelling
- insufficient detail on which specific features of virtual ward platform technologies deliver additional clinical, service or cost benefits
- variation in how outcomes were reported, particularly those related to escalation, admission and readmission
- unclear reporting across studies of virtual ward admission criteria.[2]

The NICE recommendation also stated that further evidence should be generated on the following key clinical and cost outcomes:

- length of virtual ward or hospital stay
- hospital admission and readmission rates
- number of alerts when using a virtual ward (including false-positive and false-negative alerts)
- costs and resource use (including virtual ward service delivery costs)
- patient and carer experience and acceptability (including carer burden)
- demographics of the people supported on a virtual ward (including information relating to health inequalities, and the utility of this model in certain groups, for example people with lower levels of digital literacy)
- healthcare professional experience and acceptability

- number of contacts with other healthcare providers, such as GP visits, home visits and calls to 111.[2]

Given the limitations of the existing evidence base on virtual wards, there is a clear need for ongoing data collection within the NHSScotland context. This should be supported by a structured evidence framework to ensure the consistent collection of robust and decision-relevant data. This will help to establish an evidence base aligned with NHSScotland’s definition of virtual ward. In the absence of such data, it will remain difficult to reliably assess the impact of virtual wards and associated technologies on clinical outcomes, safety, cost effectiveness and patient experience across NHSScotland.

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Appendix 1: Abbreviations

Table 5: Abbreviations used in document

CI	confidence interval
COPD	chronic obstructive pulmonary disease
DTAC	Digital Technology Assessment Criteria
GP	general practitioner
GWTG-HF	Get With the Guidelines–Heart Failure
HFVW	heart failure virtual ward
ICD-10	International Classification of Diseases, 10th Revision
ICER	incremental cost-effectiveness ratio
NHS	National Health Service
NICE	National Institute for Health and Care Excellence
PPPE	per patient per episode
RCT	randomised controlled trial
RR	relative risk
SHTG	Scottish Health Technologies Group
UK	United Kingdom
USA	United States of America

Appendix 2: Technologies identified as in use by NHS England by NICE in 2023

Table 6: 11 technologies identified as in use in NHS England by NICE in 2023

Virtual ward platform technology (company)	Main features
Clinitouch (Spirit Health)	**Clinician-facing features**: risk stratification, alarms based on sustained changes in patient vitals over time. **Patient-facing features**: currently used via a tablet provided, app released June 2023 that allows the patient to use Clinitouch on their personal mobile. Can text or video call through the app. **Devices supported**: peripheral medical devices (for example, pulse oximeter) and specified medical devices with Bluetooth automation can both be used.
Doccla Virtual Ward solution (Doccla)	**Clinician-facing features**: risk stratification, alarms based on sustained changes in patient vitals over time, detailed patient questionnaires and qualitative feedback. **Patient-facing features**: can use phone app or be loaned a tablet or smartphone, it is compliant with web content accessibility guidelines and will work with a wide range of accessibility aids, patient reminders, picture uploads, video calling. **Devices supported**: peripheral medical devices (for example, pulse oximeter) and specified medical devices with Bluetooth automation can both be used.
DOC@HOME (Docobo)	**Clinician-facing features**: alarms based on sustained changes in patient vitals over time, patient questionnaires and qualitative feedback, ability to push self-guided educational content, risk stratification. **Patient-facing features**: can use phone app or any web browser, patient reminders, text and video calls available through the app. **Devices supported**: peripheral medical devices (for example, pulse oximeter) and specified medical devices with Bluetooth automation can both be used.
Feebris (Feebris)	**Clinician-facing features**: alarms based on clinically defined set of rules or requirements, patient questionnaires and qualitative feedback, risk stratification. **Patient-facing features**: can use phone app, patient reminders and prompts, text and video calls available through the app, multilanguage support, adjustable display, offline functionality.

	Devices supported: peripheral medical devices (for example, pulse oximeter) and specified medical devices with Bluetooth automation can both be used. Continuous-monitoring devices also supported.
Huma (Huma Therapeutics)	**Clinician-facing features**: alarms based on sustained changes in patient vitals over time, patient questionnaires and qualitative feedback, risk stratification, adherence monitoring. **Patient-facing features**: app available on the patients personal or company-provided phone, patient reminders and prompts, photo and video calls available through the app, ability to push self-guided educational content, multi-language support and other digital accessibility features, **Devices supported**: peripheral medical devices (for example, pulse oximeter) and specified medical devices with Bluetooth automation can both be used.
Inhealthcare Digital Health Platform (Inhealthcare)	**Clinician-facing features**: alarm-based alerts, patient questionnaires and qualitative feedback, risk stratification. **Patient-facing features**: access through a phone app, online portal or text and automated calls. Text and video calls available through the app to clinician, request for physical follow-up. **Devices supported**: peripheral medical devices (for example, pulse oximeter) and specified medical devices with Bluetooth automation can both be used.
Luscii (Luscii Healthtech)	**Clinician-facing features**: alarms and risk stratification included, patient questionnaires and qualitative feedback included as well as general monitoring of patient vitals, connect multi-team support across primary and secondary care. **Patient-facing features**: access through a phone app, text and video call service available. **Devices supported**: peripheral medical devices (for example, pulse oximeter) and specified medical devices with Bluetooth automation can both be used. Also supports manual entries from devices.
PMD (PMD Solutions)	**Clinician-facing features**: Web-based data system, patient questionnaires, connect multi-team support across primary and secondary care, risk stratification. **Patient-facing features**: can use mobile phone app (can be provided on loan) or website from other device to access technology. text and video call available, Google translate used for multi-language purposes. **Devices supported**: vital signs monitor (pulse blood oxygen monitor, blood pressure cuff, infrared thermometer), wearable RespiraSense respiratory rate monitor.

Virtual Ward Technologies (Virtual Ward Technologies)	**Clinician-facing features**: track patient vitals and qualitative feedback, no mention of risk stratification or alerts. **Patient-facing features**: use phone app and smart watch (company can provide phone and smart watch if needed), support available via text. Highlight features of digital accessibility such as multi-language features. **Devices supported**: Smart watch, peripheral medical devices (for example, pulse oximeter) and specified medical devices with Bluetooth automation can both be used.
VitalPatch remote patient monitoring solutions (MediBioSense Ltd)	**Clinician-facing features**: alarms and risk stratification included, remote continuous-monitoring, web-based data system. **Patient-facing features**: access through a phone app (4G sim can be provided), IoT (internet of things) "Infinity" box can be provided, wearable patch to monitor vitals. Some digital accessibility features such as loT box or 4G sim provided, although limited description of other features. Video call service, which was planned to go live July 2023 **Devices supported**: MediBioSense IoT "Infinity" box. VitalPatch. 3rd party peripheral medical devices (for example, pulse oximeter) and specified medical devices with Bluetooth automation can both be used. Also supports manual entries from devices.
Whzan Blue Box (Solcom)	**Clinician-facing features**: alarms based on sustained changes in patient vitals over time, patient questionnaires and qualitative feedback, risk stratification, adherence monitoring. **Patient-facing features**: Can use mobile phone app, or through tablet or personal computer. Can use text or video calls. Digital accessibility is considered and Whzan is web content accessibility guidelines 2.1 compliant. **Devices supported**: Blue Box portable telehealth kit for manual intermittent monitoring (Bluetooth enabled thermometer, pulse oximeter and blood pressure monitor). Continuous monitoring also supported.