NATIONAL INSTITUTE FOR HEALTH AND CARE EXCELLENCE

Medical Technologies Evaluation Programme

Virtual Ward Platform Technologies for acute respiratory infections

Final scope

May 2023

1 Introduction

NICE has been asked to produce a number of related products to support and inform the expansion of virtual ward provision and other intermediate care areas. This Health technology evaluation will focus on the use of virtual ward platforms to enable the provision of virtual wards for people with acute respiratory infections. The aim is to outline key considerations and characteristics of the digital platforms, create an early economic model and identify outcomes to prioritise for future data collection. This could help support the adoption of virtual ward platforms for acute respiratory infections in the NHS. This assessment will take place as a bespoke project as part of the Health Technology Assessment Innovation Laboratory (HTA Lab) programme at NICE.

A list of abbreviations is provided in appendix A.

2 Description of Virtual Wards

This section describes the properties of virtual wards based on information provided to NICE by manufacturers and experts and information available in the public domain. NICE has not carried out an independent evaluation of this description.

2.1 Definition of a virtual ward

According to the definition provided by NHS England and NHS Improvement, a virtual ward allows people who would otherwise be in hospital to receive acute care, monitoring and treatment to receive the same level of care at home.

Purpose of virtual wards

A NHS England Transformation Directorate programme aims to develop and expand the use of virtual wards in the NHS. The ambition for virtual wards is to expand the capacity of the acute care sector by managing patients, who would otherwise be in hospital, remotely in their homes, creating potential staffing efficiencies and providing more convenient care for patients. Virtual wards could also reduce the pressure on other aspects of the care system, including primary care appointments and emergency hospital attendance.

Virtual wards are designed to provide an alternative to admission into hospital or support early discharge out of hospital. A virtual ward is not intended to be a mechanism for enhanced primary care programmes; chronic disease management; home intravenous or infusion services; intermediate or day care; safety netting; or proactive deterioration prevention.

The NHS Operational Planning guidance has sets a target to deliver 40 to 50 virtual ward beds per 100,000 population (equivalent to the delivery of up to 24,000 virtual ward beds nationally) by December 2023. Additional funding of up to £450 million over two years has been made available to systems to support this transformation.

The ambition was set following national development of acute respiratory infection and frailty pathways, which included defining the approach and resource required to support the scale of virtual wards. There is an expectation that the system will support these two pathways and there is a two-year transformation programme being initiated nationally, which will support and guide local and regional development. The acute respiratory and

frailty pathways are expected to deliver 50% of the overall bed target for virtual wards nationally.

2.2 Virtual Wards properties

Virtual wards should be technology-enabled to maximise the opportunity they offer for patients, carers and staff. A technology-enabled virtual ward platform comprises of a patient facing app or website, medical devices for measuring vital signs and a digital platform for healthcare providers to monitor patients. Here patients or their carers measure agreed vital signs using medical devices such as pulse oximeters and enter data into an app or website (manually or automatically if using a connected device). In some cases, they wear a device that continuously monitors and reports vital signs.

Clinical teams see measurements for the patients they are responsible for displayed on a digital dashboard. The platforms or technology software ensures they are alerted when any patient moves outside agreed parameters, allowing them to take appropriate action. Patients should be considered for a technology-enabled service where one exists. However, it is important that alternatives are available to avoid digital exclusion and take account of personal choice. It is also important consideration is given to other opportunities technology may offer such as the use of point of care testing or remote diagnostics to support virtual wards.

Automatic data collection

The RSET Rapid evaluation of remote home monitoring models during COVID-19 pandemic in England highlighted that the use of apps for patient monitoring allowed the follow up of more patients. It did also highlight that this method is not appropriate for everyone, with some people needing paper recording or telephone follow ups. NHS England guidance on setting up virtual wards requests the platforms to minimise the burden on providers by capturing data items that enable reporting of patient attributes, throughput, length of stay, referral and discharge routes, clinical activity and patient

outcomes by the platforms in a consistent format and linked closely to clinical data capture.

Accessibility and interoperability

NHS England guidance on virtual wards for integrated care system (ICS) leads states that virtual ward services are likely to be delivered by teams from different organisations across the ICS and relevant patient information will need to be available to all those involved. Interoperability has also been highlighted as a key feature to enable effective data sharing, aligned to the ICS's digital, data and technology strategy.

For this assessment, NICE will consider virtual wards platforms that:

- are intended for use by adults in their usual place of residence (where appropriate)
- have been developed to support a step-up or step-down pathway for adults with acute respiratory infections and have the following key features:
    - record all the necessary clinical measurements needed to remotely manage people with acute respiratory infections
    - enable the clinical team to monitor patients at home using software equipment, including an online dashboard of the vital signs
    - the technologies should be device agnostic or integrate with medical devices that have CE or UKCA mark, if required. Data can be entered manually by the user or automatically using connected devices
    - enable case management functionality (the platform ensures the clinical team is alerted when any patient moves outside agreed parameters, allowing them to take appropriate action).
    - are accessible across all staff that need to provide input (such as secondary care and community health)
    - offer direct interoperability with appropriate clinical systems (including data sharing)

- meet the standards within the digital technology assessment criteria (DTAC), including the criteria to have a CE or UKCA mark where required. Products may also be considered if they are actively working towards required CE or UKCA mark and meet all other standards within the DTAC.
- are available for use in the NHS.

In total, 20 virtual ward platforms are considered in the scope. These are listed in appendix A. The final list of included technologies may be subject to change.

3 Target conditions

The target population for this assessment is people (aged 16 and over) with a suspected or confirmed acute respiratory infection (ARI; including COVID-19) who are stable or improving but require ongoing monitoring that can be safely provided in their home or usual place of residence.

NHS England's guidance on ARI virtual wards recommends the following criteria when considering virtual ward care for people with an ARI:

- suspected or confirmed ARI including COVID-19
- oxygen saturations of 95 to 100%, NEWS2 less than 3, clinically stable or improving
- no significant respiratory co-morbidities.

People with the following clinical features may also be considered, where clinically appropriate:

- saturations of 93 to 94% or NEWS2 3 or 4, or both, with improving clinical trajectories (in people being discharged from hospital-based acute care)

- saturations of 88 to 94% (or baseline) if known chronic hypoxia, such as chronic obstructive pulmonary disease (COPD)

- frailer people should not be excluded but dedicated frailty services, such as frailty virtual wards, may be more appropriate where these exist locally

- pregnant people with saturations greater than 94% should not be excluded and early maternity involvement should be sought for specific advice around management of suspected ARI including COVID-19 in pregnancy.

People with the following clinical criteria should be excluded:

- unstable or worsening clinical trajectory, such as saturations less than 93% (unless confirmed baseline) or NEWS2 greater than or equal to 5, or both

- severe or life-threatening presentations of pneumonia, asthma or COPD

- suspected sepsis

- chest pain that is concerning for a serious cause requiring immediate hospital transfer, such as acute coronary syndrome

- pregnant people with saturations of less than or equal to 94%.

It also recommends that clinical judgement is key for all assessments, particularly for people at higher risk of serious illness, people with a learning disability or people with serious mental illness.

3.1 Care pathway

Virtual ward services for ARI are intended for people who need acute level care and would otherwise be in hospital. It is not intended for chronic disease management. The ARI virtual ward supports both an admission alternative to hospital and early supported discharge from hospital.

Clinical assessment to assess suitability for admission to a virtual ward should be carried out in person by a clinician. It should include a review of symptoms,

function, clinical observations, appropriate diagnostics, clinical severity scoring, overall clinical trajectory and a shared decision-making discussion about any support requirements for the patient or their carers. Suitability of the patient's usual place of residence also needs to be considered, such as access to a fixed or mobile telephone line, running water and electricity. Patient's or their carers would also need the motivation and skills to be able to use a virtual ward platform and the associated medical devices.

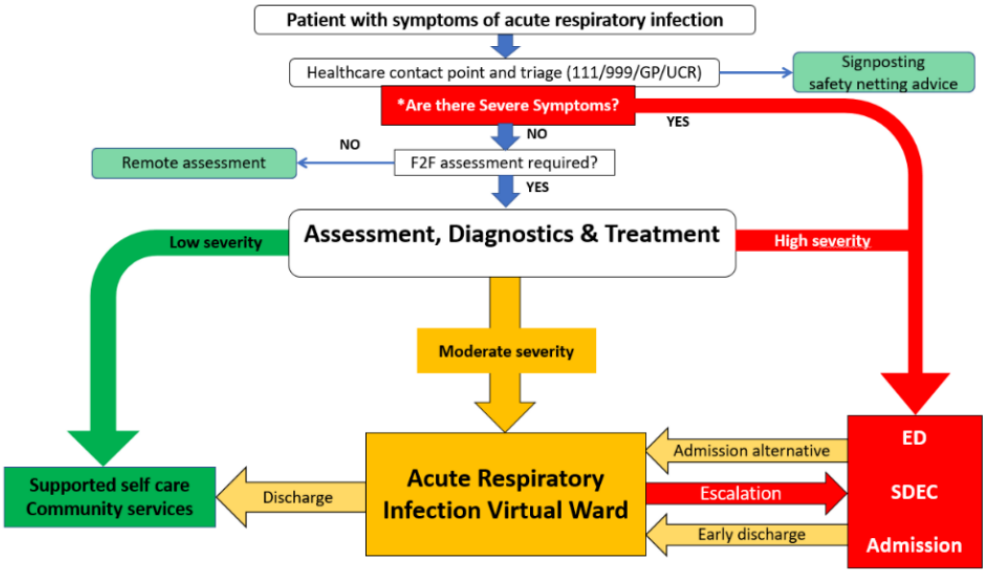
Virtual wards should be delivered by a multidisciplinary team, if clinically appropriate, led by a named consultant practitioner (including a nurse or consultant allied health professional) or suitably trained GP with relevant experience and training, with clear lines of clinical responsibility and governance.

Services may need to develop their own admission and discharge criteria for acute level care in line with their population needs, available workforce and competencies. Healthcare practitioners need a clear pathway for recognising deterioration and escalating care, including the use of clinical acuity scoring such as NEWS2. Patients and their carers need clear information on who to contact if their symptoms worsen, including out of hours.

Potential place of virtual wards in the care pathway

NHS England's ARI virtual ward guidance proposes the pathway shown in figure 1. This pathway includes clinical assessment to assess suitability for admission to a virtual ward from either a hospital setting as an early discharge or alternative to admission or via direct patient NHS contact. The assessment includes a review of the patient's symptoms, function, clinical observations, appropriate diagnostics, clinical severity scoring, overall clinical trajectory and a shared decision-making discussion about any support requirements for the patient or their carers. On admission to a virtual ward, plans relating to monitoring, escalation of care and discharge are made. The expected length of an admission is up to 14 days, subject to clinical judgement.

Figure 1: Proposed pathway for the use of virtual wards in people with acute respiratory infection



Source: [NHS England's acute respiratory infection virtual ward guidance]

Related NICE Guidance

- Acute Respiratory Infection in over 16s: Initial assessment and management (in development) NICE guideline GID-NG10376
- COVID-19 rapid guideline: managing COVID-19 (2021, updated 2022) NICE guideline NG191
- Pneumonia (community-acquired): antimicrobial prescribing (2019) NICE guideline NG138
- Cough (acute): antimicrobial prescribing (2019) NICE guideline NG120
- Emergency and acute medical care in over 16s: service delivery and organisation (2018) NICE guideline NG94
- Sepsis: recognition, diagnosis and early management (2017) NICE guideline NG51

3.2 Patient issues and preferences

Virtual wards platforms are delivered via smart digital devices along with the associated monitoring devices, allowing for monitoring from a patient's place of residence. This may be particularly appealing to people who do not want to be treated in hospital.

Suitability of the patient's usual place of residence needs to be considered, such as access to a fixed or mobile telephone line, running water and electricity. Additionally, some people may not to want to be monitored from their place of residence using a virtual ward platform and prefer monitoring in hospital. There may be concerns about the level of support provided and the safety of being monitored remotely. The risks and benefits of virtual ward use needs to be communicated to patients prior to use. Consideration is also needed on to the ability of patients to consent to using a virtual ward, including those with dementia or receiving end of life care. People have the right to make informed decisions about their care, including the use of virtual ward platforms.

The Ofcom Adults' Media Use and Attitudes report states that 6% of households (around 1.7 million) did not have access to the internet at home in December 2021 (Ofcom report, 2022). The groups more likely not to have internet access at home are those aged 75 and over (26%), those in a lower socioeconomic household classification (DE social grade; 14%) and those who are most financially vulnerable (10%). Digital exclusion would need to be considered when offering the use of a virtual ward platform. Support in the form of internet access, access to a smart device, and training on using the virtual ward platform would be needed for those who do not have access to these technologies or who may not be confident in using digital technologies. Patient facing aspects of virtual ward technologies need to be easy to use, to ensure accessibility to people who may have limited digital literacy skills.

Relevant monitoring devices will need to be loaned in order to use a virtual ward. Patients and carers will need training on how to use the devices and when they need to submit readings as well as any additional questionnaires. Clear information would need to be provided on when and how a patient or carer can self-escalate if symptoms are getting worse.

4 Comparator

Technology-enabled virtual wards would be used as an alternative to inpatient secondary care, for those who are eligible for treatment from home.

5 Scope of the assessment

Table 1: Scope of the assessment

Populations	• Adults (aged 16 or over) referred for hospital admission with acute respiratory infection. • Adults (aged 16 or over) admitted to the hospital with acute respiratory infection who are stable or improving but require ongoing monitoring. Treatment using virtual wards should also be based on the criteria listed under target conditions. Subgroups could be considered for health inequalities and those with co-morbidities.
Interventions (proposed technologies)	• Technology-enabled virtual ward platforms for treating adults with acute respiratory infections, as an alternative to inpatient hospital care • Technologies would need to meet the eligibility criteria listed in section 2.3. A list of technologies provisionally identified are listed in appendix A. This list of technologies is not exhaustive and may be subject to change.
Comparator	Inpatient hospital care or care in the community or a patient's usual place of residence without the use of a virtual ward platform
Healthcare setting	Care from the patient's usual place of residence
Outcomes	Intermediate measures for consideration may include: • Number of people in treatment and their respective demographics • Number of people in which treatment is escalated
	Clinical outcomes for consideration may include: • Length of hospital or virtual ward stay • Rate of hospital- acquired infections • Mortality Operational and service level clinical outcomes: • Number of admissions to a hospital or virtual ward • Number of hospital readmissions • Emergency attendance or unplanned hospital admissions • Number of contacts with other care providers such as GP visits, 111 calls • Release of staff time for other caring responsibilities • Ease of use and acceptability of virtual ward by healthcare professionals • Patient adherence to scheduled reporting of clinical outcomes or use of wearable technologies • Waiting time for admission to or discharge from a virtual ward

	• Antimicrobial use • Interoperability with electronic health records • Adverse events
	Patient-reported outcomes for consideration may include: • Health-related quality of life • Patient and carer experience (including preferable place of care and carer strain) • Patient and carer acceptability
	Costs will be considered from an NHS and Personal Social Services perspective. Costs for consideration may include: • Costs of the technologies • Cost of other resource use
Time horizon	The time horizon for estimating clinical and cost effectiveness should be sufficiently long to reflect any differences in costs or outcomes between the technologies being compared. For people with acute respiratory infection a time horizon of 30 days is considered long enough to capture all outcomes related to the intervention and the condition. Sensitivity analysis will be undertaken to address uncertainties in the model parameters.

6 Other issues for consideration

Characteristics of virtual ward platforms

- There are a wide range of platforms which can deliver virtual wards. The technologies listed in this scope are those identified as being used for acute respiratory infections in the NHS. This list is not definitive and can be subject to change throughout the evaluation period.
- There are common features between virtual wards, with all technologies offering a patient app and clinician platform. Some technologies are device agnostic and some provide set monitoring devices. There is also variation in interoperability of the platforms and different NHS patient record systems. Interoperability with electronic health records in primary and secondary care was highlighted as a key functional aspect of virtual ward platforms.

Patient population

- There are a wide range of people that could be offered a virtual ward for acute respiratory infections. Additional considerations are needed for people with co-morbidities or those who might be stepped down from hospital care but who still require oxygen.

Although a length of stay of up to 14 days may be expected for most, some people may be on a virtual ward for longer.

Evidence

- This assessment will look across a range of evidence types including randomised controlled trials, real world evidence and grey literature. Evidence considered will include evidence of clinical effectiveness and comparative outcomes to inpatient care, where available.

- This evaluation is focused on the overall quantity and quality of evidence for virtual ward platforms for acute respiratory infections. If there is insufficient evidence in this area, the scope of the literature review may be expanded to other virtual wards populations, where appropriate.

7 Potential equality issues

NICE is committed to promoting equality of opportunity, eliminating unlawful discrimination and fostering good relations between people with particular protected characteristics and others.

- Technology-enabled virtual wards are often delivered through a smart device. People need regular access to a device with internet access to use the technologies. Additional support and resources may be needed for people who are unfamiliar with digital technologies or do not have access to smart devices or the internet.
- People with cognitive impairment, problems with manual dexterity, learning disabilities or who have difficulty reading or understanding health-related information may need additional support to use technology-enabled virtual wards. This should be considered when selecting and delivering these interventions.
- Technology-enabled virtual wards should be accessible to people with visual impairments using screen readers, and people with hearing impairments.
- People with English as a second language may have difficulties navigating technology-enabled virtual wards provided in English. Technology-enabled virtual wards providers should consider how to translate these interventions or provide additional support as needed.
- Acute respiratory infections are more common in people who are 65 and Over. This population also has a higher risk of serious illness and worse outcomes.

- People with learning disabilities have higher rates of asthma, COPD and upper respiratory tract infections and poorer measured lung function.
- Pregnant people are at greater risk of developing complications due to acute respiratory tract infections.
- Some pulse oximetry devices have been reported to overestimate oxygen saturation levels in people with darker skin, which may lead to them not being treated when treatment is needed.
- There is evidence to suggest that there is a higher incidence of mortality from respiratory disease in England for men than women. There are differences in help seeking behaviour between men and women, which may increase a man's risk for pneumonia hospitalisation.

Age, sex, disability, race, and pregnancy are protected characteristics under the Equality Act 2010.

8 Potential implementation issues

Training

Training and appropriate staffing is required to facilitate virtual wards. Patients and carers will need training on how to take the required measurements and report them on the virtual ward platforms. Training on escalation processes should also be provided to carers, staff, the multidisciplinary team as necessary.

Cost

Costs may differ between technologies. Smaller service areas may have higher costs per user due to not needing as many licences for the technology. Some technologies may be used for other conditions within the virtual ward service, which may reduce the overall implementation cost. As multidisciplinary teams are needed to deliver virtual wards, the cost of the staffing models would form a key part of the cost. Consideration is needed as to whether a virtual ward company or an NHS provider provides some logistical functions such as maintaining and supplying monitoring equipment as well as providing reminders for patients to submit recordings.

Digital exclusion would need to be considered as part of implementation. This includes the provision of necessary equipment, support and training and

mobile data or WiFi access to those who want to use a virtual ward but do not have the resources to do so.

Risk of harm

Patients should be screened based on the eligibility criteria outlined by NHS England's guidance on acute respiratory infection virtual wards. Patients should be given clear information on who to contact if their symptoms worsen, including out of hours. Staff should have clearly defined roles within the multidisciplinary team. There should be clear pathways to support early recognition of deterioration and appropriate escalation processes in place to maintain patient safety. For out of hours care, a clear support plan is needed. This may require a specially commissioned primary care service, if the virtual ward is run by a secondary care service. All teams responsible for patient care would need access the virtual ward platform. In addition to this, consideration of connectivity and safety plans if contact is lost with a patient is needed.

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Appendix A

Table 1: Technologies considered in the scope
To note, this information has been provided by a company or through review of publicly available information. As a result, the level of detailed information varies. This list is not exhaustive and may be subject to change following provision of additional information.

Accurx (Accurx)	Accurx offers a virtual ward platform. The technology can integrate with EMIS, TPP and Vision.
Andersen (Andersen)	Andersen is a software development company with remote patient monitoring software to continuously track patient health.
Baywater Healthcare (Baywater Healthcare)	Baywater Healthcare provides patient monitoring services for a range of conditions including offering a COVID-19 virtual ward.
Camascope (Camascope)	The Camascope platforms supports the use of virtual wards. The technology has wearable devices and custom forms can be created for individual patients or entire patient groups to periodically provide further information on their health. Patients receive custom alert messages when vital signs go outside of pre-defined parameters. Video calls can be held between patient and a clinical team to ensure full support is available during remote monitoring. The company provide continual support if there are any questions. Camascope integrates with GP Systems, such as EMIS.
Clinitouch (Spirit Health)	CliniTouch is a digitally connected health care platform that provides remote monitoring. It is designed to prioritise patients by clinical need, allowing the clinician to see when a patient's condition is likely to deteriorate, prompting them to take pre-emptive measures. The platform enables the digitisation of multiple care pathways. It has a patient app where patients answer predefined questions and submit health data, at intervals set by their clinician. This app is currently accessed via a supplied tablet. The clinician dashboard has a smart algorithm which converts question sets and health data into a red, amber or green rating to make it easier to spot deterioration. Clinitouch can integrate with any peripheral measurement device using Bluetooth or manual data entry. This includes those which measure oxygen levels, temperature and heart rate. The technology is not currently interoperable with core clinical systems. The company provide virtual training sessions to clinicians and service

	administrators to on the use of the system. Supplementary user guides are also provided.
Current Health (Current Health)	The Current Health system is a remote patient monitoring platform. It works alongside the Current Health wearable device which provides continuous and intermittent vital sign measurements including oxygen saturation, respiratory rate, mobility and step count, pulse rate, blood pressure and skin temperature. Devices come pre-configured for easy patient set up. The company can provide a tablet with data access or a patient can use the Current Health app on their own device. The platform provides physiological alarm notifications, triage, escalation and video visiting. The alarms are tailored to clinical pathways and specific patient populations and are based on sustained changes to vital signs over time. The company provides a quick start guide for patients, which is translated into 30 languages. The company also provides continuous support for patients using the technology, in addition to a clinician training programme. Interoperability with electronic patient records is primarily done through the public API of the electronic patient record.
Doccla Virtual Ward solution (Doccla)	Doccla Virtual Ward solution is a remote monitoring platform which can be adapted to any care pathway. Patients have access to an app to submit vital signs (such as temperature, blood oxygen and blood pressure) and other information about their condition. The platform is device agnostic so patients can enter vital signs manually or using Bluetooth connected devices. The app also gives the patient automatic nudges and reminders to submit information. Patients are supplied with a smartphone or tablet, with 4G data plans, to ensure connectivity if the patient cannot connect to WiFi. A clinician dashboard allows real time access to the information submitted by their patients. The clinical dashboard also shows the text of the last outbound or inbound message from a patient, and whether or not it has been read. The technology allows content, timing and logic of patient questionnaires to be adaptable, and can be set by default for all the patients on a pathway or customised to suit individual patients. The technology can integrate with SystmOne, EMIS, Cerner, EPIC and through TIE's Sunrise and RIO. The company provide patient support and a helpline for clinicians.

	The company also uses NHS-approved translation services for those who do not speak English well.
DOC@HOME (Docobo)	DOC@HOME is a remote patient monitoring platform for a range of conditions. Patients can record data via a CAREPORTAL device, DocoboAPP, DocoboWeb, or via SMS for simple vitals (such as blood pressure or oxygen saturation). The technology is compatible with a range of connect devices which will automatically submit readings as well as allowing manual data entry. There is a library of template questionnaires or the ability to create new questionnaires to capture soft sign data from patients. There is also a secure two-way messaging between patient and healthcare professionals. DOC@HOME can be configured to generate alerts based off vital sign parameters, soft signs, and scores. Alerts are coded by risk and can be standardised across an entire patient cohort or tailored to a patient's normal parameters. DOC@HOME integrates into other core clinical or care systems such as EMIS, Care Centric and Nourish. Self-help educational content can also be sent to patients and there is a technical support desk for all service users during normal business operating hours. The company offers training for healthcare professionals and patients can receive training from either a healthcare professional or by a company field technician.
Doctaly Assist (BDM Medical)	Doctaly Assist is a remote patient monitoring platform. The technology allows patients to provide their symptoms and vital signs for a clinical to review remotely. A prioritisation system is used to make sure care is escalated where needed.
Dignio (Dignio)	The Dignio platform can be used for a wide range of applications. It has 3 aspects the platforms, a patient application called MyDignio, a web-based patient monitoring portal called Dignio Prevent, and a tool for caregivers on the go called Dignio Care. The platform is device agnostic and so data can be inputted manually by the patient or by using Bluetooth-integrated medical devices. The platform integrates with the core clinical system EMIS.
Feebris (Feebris)	Feebris is a cloud based, device agnostic, virtual ward platform. Vital signs and symptoms can be entered manually or by using Bluetooth-integrated medical devices. The technology uses AI-review to provide immediate feedback to the user if measurements need to be retaken or any other

	changes in the use of the sensors need to be made. Customisable questionnaires can also be used to capture soft signs. The app operates entirely offline so that patient data can be captured regardless of connectivity. A mobile device with data is provided to patients. There are accessibility functions including the patient facing app being picture based, voice access and spoken feedback, and adjustments to display and font size can be done. The clinical portal provides a top-level summary of patients on the ward including RAG-rated vitals, stratification to allow prioritisation and configurable alerts. The technology has a FHIR API to integrate with primary care systems (EMIS and SystmOne) and secondary care systems (EPIC and Cerner). The company provide training for clinical staff and a virtual learning hub. Onboarding of patients can be done by clinical staff or the company.
Health Call (Health Call)	Health Call offer a virtual ward platform for a range of acute and chronic health conditions including respiratory and COVID-19. Patients are sent reminders to submit a range of core observations including heart rate, blood oxygen levels and respiratory rate. A clinician dashboard shows patients who are breaching parameters and require urgent attention. The technology integrates with all electronic patient record systems.
Huma (Huma)	Huma virtual ward platform comprises of a patient facing app and web-based clinician platform. A patient can input core clinical parameters into the app including, oxygen saturations, temperature, heart rate and blood pressure manually or using Bluetooth-integrated medical devices. They can also respond to questionnaires. Additionally, there is a helper feature to enable a carer or proxy to enter data for a patient. The clinician platform can provide alerts if patients measures move outside of agreed parameters, with threshold-based flagging systems. The technology allows video conferencing or messaging between healthcare professionals and the patient. Huma can integrate with TPP SystmOne and EMIS The company provide technical support for healthcare professionals and patients.
Inhealthcare Digital Health Platform (Inhealthcare)	The Inhealthcare Digital Health Platform is a single platform which allows the management of multiple patient monitoring services. Patients can provide vital sign measurements and respond to questionnaires

	for clinicians to review. The platform is device agnostic and so data can be inputted manually by the patient or by using continuous monitoring devices, Bluetooth-integrated medical devices, responding via SMS or automated phone calls. The platform integrates with core clinical systems SystmOne and EMIS Web and can share data to GP practices that do not have Inhealthcare applications installed via the MESH. The platform is operated as a Software as a Service Platform and therefore can be accessed by any staff that need it. There is access to a service desk, learning management system and knowledgebase as well as user guides to support use of this platform.
Lenus COPD Support Service (Lenus Health)	The Lenus COPD Support Service provides a remote monitoring and virtual ward platform to support people with a range of respiratory conditions, including acute respiratory infections. The platform allows patients to submit structured questionnaires as well as data from medical devices. A clinical dashboard allows healthcare professionals to assess the patient's wellbeing remotely. Alert lists highlight patients who have messaged, or whose measurements are outside of expected parameters. The technology can integrate with existing electronic health record systems. Clinicians using the system are given training (virtual and in-person) on how to use the technology, in addition to ongoing support.
Luscii (Luscii Healthtech)	Luscii supports virtual wards for a range of conditions including acute respiratory infections. Patients can provide vital sign measurements and respond to questionnaires for clinicians to review using an app on a smart phone or tablet. Luscii is device agnostic and so vital sign data (such as blood oxygen and temperature) can be inputted manually by the patient or by using Bluetooth-integrated medical devices. If needed, the company can loan tablets with WiFi or data to patients. Clinicians access Luscii via a web-based dashboard. Thresholds can be set at a cohort and individual level if required, so that any measurement outside of a specific threshold or combination of thresholds will trigger an automatic alert to the clinical team. Direct contact can then be made if required via in-app secure messaging or in-app video calling. The company works with either third party partner providers who create dedicated clinical monitoring teams or with existing staff within

	the care provider's teams, or a combination. Specific educational content can also be provided to encourage and support self-management. A support desk is available, via phone or in-app chat, for both patients and clinicians. The technology can integrate with existing electronic health record systems including Epic, Cerner and SystmOne.
RespiraSense Hub (PMD Solutions)	Respirasense Hub is a remote monitoring service. It comprises of a web based and mobile app platform, a continuous respiratory rate monitor (RespiraSense), and the use of additional medical devices to measure other vital signs. The RespiraSense respiratory rate monitor is a rechargeable motion-tolerant device for continuously monitoring respiratory rate. The company additionally loans the use of vital sign monitors for pulse rate, peripheral blood oxygen saturation, blood pressure and temperature. The company can also loan a mobile device, if required. Data can be collected using Bluetooth-enabled medical devices or manually entered. Data collected is displayed on the clinician dashboard. The dashboard also allows the creation of patient questionnaires, two-way communication to the patient via text or video call, and interoperability with GP services. The company provides nursing staff to onboard patients and provide both patient and provider with continual phone support, 2 home visits per patient, and 6 hours of one-to-one support outside of phone support.
Virtual Ward Technologies (Virtual Ward Technologies)	Virtual Ward Technologies offers a virtual ward platform which involves risk stratification and remote monitoring. The technology uses a smart watch to collect vital sign measures automatically. Patients can also manually input data such as blood pressure and symptom reporting. The company state that no patient training is needed. Healthcare professionals using the platform would need training.
VitalPatch remote patient monitoring solution (MediBioSense Ltd)	VitalPatch is a 7-day wearable disposal patch. It measures electrocardiogram (ECG), heart rate, RR interval, respiratory rate, body temperature, posture, fall detection, and activity including steps. Blood pressure and oxygen saturation can also be collected using additional devices. The data from the VitalPatch and additional devices is collected via Bluetooth using a mobile device or via the MediBioSense internet of things box called Infinity. The data is sent to the HealthStream cloud platform

	or integration into electronic health record systems for review. Patient alerts are configurable on an individual patient basis with the default alert levels based on NEWS2 guidelines. Training is provided and technical support is available.
Whzan Blue Box (Solcom)	The Whzan is a cloud based triaging dashboard that delivers remote monitoring of patients. Vital sign and assessment data is collected from patients via the Blue Box. The Blue Box is a portable telehealth kit comprising of a tablet or smartphone connected to Bluetooth enabled thermometer, pulse oximeter and blood pressure monitor for automated data collection. Assessments can also be completed on the smart device to record other parameters such as a NEWS2 score or a condition specific questionnaire. The data collected is then transferred to the Whzan dashboard. Whzan is interoperable with EMIS, SystmOne, PDS, Adastra, NRL, PARIS and some NHS local record systems. There is access face-to-face training for NHS staff, in addition to a support desk, user guides and help documents for patients and clinicians to support use of this platform.

Abbreviations

ARI	Acute respiratory infection
COPD	Chronic obstructive pulmonary disease
DTAC	Digital technology assessment criteria
EVA	Early value assessment
ICS	Integrated care system
MTEP	Medical technologies evaluation programme
NEWS2	National Early Warning Score 2