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REVIEW

Virtual wards: a rapid evidence synthesis and implications for the care of older people

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Abstract

Background: Virtual wards are being rapidly developed within the National Health Service in the UK, and frailty is one of the first clinical pathways. Virtual wards for older people and existing hospital at home services are closely related.
Methods: In March 2022, we searched Medline, CINAHL, the Cochrane Database of Systematic Reviews and medRxiv for evidence syntheses which addressed clinical-effectiveness, cost-effectiveness, barriers and facilitators, or staff, patient or carer experience for virtual wards, hospital at home or remote monitoring alternatives to inpatient care.
Results: We included 28 evidence syntheses mostly relating to hospital at home. There is low to moderate certainty evidence that clinical outcomes including mortality (example pooled RR 0.77, 95% CI 0.60–0.99) were probably equivalent or better for hospital at home. Subsequent residential care admissions are probably reduced (example pooled RR 0.35, 95% CI 0.22–0.57). Cost-effectiveness evidence demonstrated methodological issues which mean the results are uncertain. Evidence is lacking on cost implications for patients and carers. Barriers and facilitators operate at multiple levels (organisational, clinical and patient). Patient satisfaction may be improved by hospital at home relative to inpatient care. Evidence for carer experience is limited.
Conclusions: There is substantial evidence for the clinical effectiveness of hospital at home but less evidence for virtual wards. Guidance for virtual wards is lacking on key aspects including team characteristics, outcome selection and data protection. We recommend that research and evaluation is integrated into development of virtual ward models. The issue of carer strain is particularly relevant.

Keywords: older people, frailty, virtual wards, hospital at home, rapid evidence synthesis

Key Points

- Virtual wards are a rapidly evolving area of healthcare transformation.
- Rapid evidence synthesis is an approach to synthesising existing research that focuses on existing evidence synthesis.
- There is a significant evidence base for hospital at home, and less evidence for virtual wards.
- Research and evaluation should be integrated into development of virtual ward models of care for older people.

Introduction

The concept of virtual wards has existed for some time [1,2]. During the pandemic, the use of virtual wards was expanded with apparent good effect to manage selected patients with COVID-19 using a pulse oximeter and monitoring through secondary care [3]. Subsequently, large-scale investment is being made to support virtual ward expansion in the NHS to include patients with frailty [4]. To support integrated care systems and service providers to establish and expand virtual wards, two high priority pathways have been introduced [5], acute respiratory tract infection virtual wards and hospital at home for those with frailty [4]. This is a seismic shift to the way healthcare is to be delivered for older people, and an area that is currently being prioritised for funding.

The British Geriatrics Society (BGS) has previously published guidance outlining many of the principles for successful home based services [6]. Over time, the concept of the virtual ward has undergone evolution and change, and there are various extant definitions of virtual wards as a model of care. This undoubtedly represents flexibility in response to the capacity of health systems and the needs of patients. At one end of the spectrum are models that primarily use remote monitoring technology to achieve 'virtual' care (exemplified by use of home pulse oximetry in COVID-19 patients) [7], whereas at the other end are models that may use remote methods to develop a care plan but rely on multidisciplinary teams to deliver high levels of in-home in-person care [8]. In current NHS documentation, a virtual ward is defined as:

> a safe and efficient alternative to NHS bedded care that is enabled by technology. Virtual wards support patients who would otherwise be in hospital to receive the acute care, monitoring and treatment they need in their own home. This includes either preventing avoidable admissions into hospital or supporting early discharge out of hospital [9].

As the title of the NHS Guidance Note 'Frailty virtual ward (Hospital at Home for those living with frailty)' suggests, there is considerable overlap and even confusion about the use of the terms 'virtual ward' and 'hospital at home', which reflects actual variance in practice as well as terminology [4]. This is addressed in the recent BGS report that draws on the work presented here [10]. This emphasises that, in practice, there is often considerable overlap between hospital at home and virtual wards: there is a continuum of care provision in conjunction with remote monitoring in virtual wards, and this overlap is greatest where care needs are the highest—in older patients with higher levels of frailty, with long-term conditions [6]. Within the NHS England model:

> Virtual Wards for older people operate in a similar way to hospital at home, with the vast majority of care being face-to-face [10].

Box 1 summarises the terminology often used, but there is a close relationship between services described as virtual wards and hospital at home. This means that evidence on hospital at home services is directly relevant to virtual wards serving older people, whereas evidence on remote monitoring may be less directly relevant.

Box 1. Services and terminology used in practice

Virtual wards, hospital at home and remote monitoring

- **Hospital at home** services provide face-to-face care at home through a multidisciplinary team (MDT) based in the community. They are provided as an alternative to inpatient care [11].
- **Virtual wards** are a hospital-led and managed alternative to in-patient hospital care that is enabled by technology. They enable the delivery at home of acute care, monitoring and treatment to prevent admissions or support early discharge [12]. They use a variable combination of remote monitoring and face-to-face care, and may incorporate remote monitoring, for example, through apps, technology platforms, wearables and devices such as pulse oximeters [3].
- **Remote monitoring** includes aspects of many virtual wards but is a broader term and is not always restricted to people who would otherwise require inpatient hospital care.
- **Step-up models of care use virtual wards or hospital at home** as an **alternative to avoid** inpatient admission to hospital.
- **Step-down models of care** use early discharge to **virtual wards or hospital at home** for a condition that would have otherwise required continuation of hospital inpatient care.

In order to inform wider implementation of virtual wards in Greater Manchester in the North West of England, we carried out a rapid evidence synthesis (RES) of existing systematic reviews of virtual wards, hospital at home and remote monitoring as alternatives to acute hospital admission or stay.

Because of the close relationship between virtual wards and both hospital at home and remote monitoring we searched for, and included, systematic reviews relating to any one of these, where the service was provided as an alternative to inpatient hospital admission. We summarise and contextualise the findings here; for the full RES, including all references, please see Supplementary Information (Appendix 1).

Objectives

To rapidly synthesise evidence from existing evidence syntheses, which was relevant to the clinical and cost-effectiveness of virtual wards; the barriers and facilitators to their use; the ways in which they are used; and the experience of patients, carers and staff. For this paper, we have adopted a focus on the relevance of the evidence to older people and people with frailty.

Methods and search strategy

We employed a methodology outlined in our RES framework, described briefly below [13, 14].

The following eligibility criteria were used:

- Population: people who would otherwise require acute hospital inpatient care. People who required acute mental health care were excluded. We pre-specified the following subgroups as being of particular interest: people with acute respiratory conditions including chronic obstructive pulmonary disease (COPD) exacerbations or COVID-19; people with heart failure; people with frailty but did not restrict the RES to reviews focusing on these conditions. For this paper we have excluded the reviews dealing with COVID-19.
- Intervention: hospital at home; virtual ward; remote monitoring. We included both step-up (hospital admission avoidance) and step-down (hospital early supported discharge) models.
- Comparator: acute inpatient care
- Outcomes: outcomes were pre-specified for each key question and are reported below
- Study design: systematic reviews or other evidence syntheses

We accepted authors' definitions of the populations, interventions, comparators and outcomes; we required reviews to have systematic searches and clear inclusion criteria.

In March 2022, MEDLINE OVID, CINAHL-PLUS EBSCO and the Cochrane Database of Systematic Reviews were searched using a strategy devised by an information specialist based on the interventions of interest (Supplementary Material, Appendix 2). We also searched medRxiv for relevant preprints and checked the references of identified reviews.

Where we identified more than one relevant systematic review for a particular question or outcome, we prioritised Cochrane reviews where available and recent. In the absence of a relevant or up to date Cochrane review, we gave priority to reviews that reported using rigorous methodology appropriate to the review question addressed. We compared findings with other reviews addressing the same question and checked whether the same primary studies were included in the different reviews. Where we had a high-quality review and a more recent but less rigorous review, we narratively synthesised the more recent evidence alongside the original review findings. We used summary estimates of effect and assessments of the quality of the included studies, including, where possible, existing GRADE assessments of the certainty of the evidence [15].

Results

The search identified 630 unique records. Following full-text screening of 52 records, 36 publications relating to 28 unique reviews were included (Figure 1) [11,16–42]. This included four Cochrane reviews [11,16–18]. The key characteristics of the included reviews, including population age in included studies, are shown in Table 1.

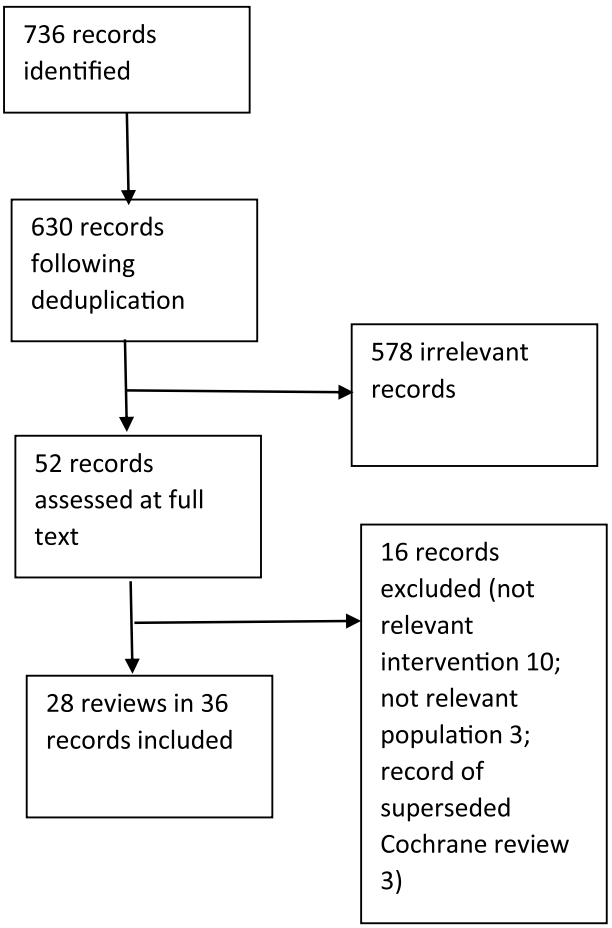

Figure 1. PRISMA diagram showing flow of studies in the RES.

Reviews and the primary studies they included often had restrictive, sometimes condition-specific inclusion criteria for participants. Five reviews limited their inclusion criteria to older people while nine others included only people with medical conditions that predominantly impact older people. Although many included reviews did not use age or frailty as inclusion criteria, most participants included in the reviews were older and/or had one or more chronic conditions (whether or not these were used as inclusion criteria). Where reported in the reviews, the mean or median age in included studies ranged between 43 and 88 (Table 1). For example, in the Cochrane review of step-up hospital-at-home, mean participant ages ranged from 70 to over 80 years, whereas one trial included only older people with frailty and dementia [11]. The identified Cochrane reviews were included in a rapid review of hospital at home as a component of the frailty pathway [42].

Specific conditions for which we identified reviews were as follows: COPD [17, 25, 26], heart failure [29–32], pulmonary embolism [27] and people at the end of life [18].

Table 1. Characteristics of included reviews

Review	Type of review	Questions addressed	Model assessed (authors' term)	Population inclusion criteria	Population age	Type of included studies	Number of included studies	Number of participants	Quality assessment
Arsenault-Lapierre 2021 [19]	Systematic review	Effectiveness Cost-effectiveness	Step-up hospital at home	Chronic disease presentation at ED	Median age 71.0 years	RCT	9	959	Cochrane risk of bias
Caplan 2012 [24]	Systematic review	Effectiveness	Hospital at home	People aged >16 years	Subgroups reported for mean ages <70, 70-73 and > 74 years	RCT	61 (not all relevant population)	Not reported	Cochrane risk of bias EPOC criteria
Chalmers 2011 [28]	Systematic review	Effectiveness (indirectly relevant) Experience	Care in community (where usual care is admission)	Community-acquired pneumonia	Not reported	Controlled studies	6	5,092	Narrative discussion
Chua 2022 [37]	Meta-synthesis	Barriers and facilitators Experience	Hospital at home	Adult patients, caregivers, HCP, or administrators	Not applicable/ not reported; two studies in geriatrics	Qualitative or mixed methods studies	16	Not reported, all relevant groups represented	CASP
Conley 2016 [22]	Overview of reviews	Effectiveness Experience Cost-effectiveness	Alternatives to hospital admission	People with acute medical conditions	Not reported	Systematic reviews	25 reviews (123 studies) (not all relevant intervention)	Not reported	R-AMSTAR
Echevarria 2016 [25]	Systematic review	Effectiveness Cost-effectiveness	Step-down hospital at home	COPD—people attending ED with exacerbation	Not reported	RCT	8	>726	Cochrane risk of bias
Goncalves-Bradley 2017 [16]	Cochrane systematic review	Effectiveness Experience Cost-effectiveness	Step-down hospital at home	Adults eligible for early discharge hospital at home	Where reported mean/median ranged from 43 to 84	RCT	32	4,746	Cochrane risk of bias GRADE
Goossens 2020 [36]	Systematic review	Cost-effectiveness	Hospital at home	People with acute conditions	Not reported	Cost analyses based on RCTs, controlled non-randomised studies, observational studies or decision models	48	Number included in cost analyses not reported	Quality of Health Economic Studies
Huntley 2017 [20]	Systematic review and overview of reviews	Effectiveness	Alternatives to hospital admission	People over 65 years at risk of unplanned hospital admission	NR for hospital at home; 15/19 primary studies included people aged >75 years	RCTs, controlled non-randomised studies, systematic reviews	19 studies 7 reviews Not all relevant	Not reported	Cochrane risk of bias AMSTAR
Jeppeson 2012 [17]	Cochrane systematic review	Effectiveness Cost-effectiveness Experience	Hospital at home	COPD acute exacerbations	Where reported mean ranged from 67 to 80 years	RCT	8	870	Cochrane risk of bias
Jester 2015 [40]	Review including review of reviews	Effectiveness Cost-effectiveness Experience	Hospital at home	Adults with chronic conditions or post-surgery	Not reported	RCTs, quasi-experimental studies, observational studies, systematic reviews	28 studies including 2 reviews	Not reported	CASP

(continue)

Table 1. Continued.

Review	Type of review	Questions addressed	Model assessed (authors' term)	Population inclusion criteria	Population age	Type of included studies	Number of included studies	Number of participants	Quality assessment
Kast 2021 [33]	Systematic review	Cost-effectiveness	Transitional care defined as home visits combined with telephone calls coordinated by one responsible person	Geriatric patients (aged >65 years) with multiple diseases or at least on chronic disease	Not reported	Studies reporting quantitative cost measures (RCTs and observational studies)	3	742	Consensus Health Economic Criteria National Heart, Lung & Blood tools
Lee 2022 [35]	Systematic review	Effectiveness Experience	Transitional care	Older adults with frailty aged >65 years	Mean age ranged from 77 to 86 years	RCT	14 most not directly relevant	5,776	Cochrane risk of bias 2
Leong 2021 [21]	Overview of reviews	Effectiveness Cost-effectiveness Barriers and facilitators	Hospital at home	Adult patients	Not reported	Systematic reviews	10 reviews including 100 unique studies	Not reported	AMSTAR-2
Li 2021a [31]	Systematic review	Effectiveness Experience	Transitional care	Heart failure, aged >55 years	Mean age ranged from 59 to 80 years	RCTs, cluster RCTs	42 (not all directly relevant)	10,784	Cochrane risk of bias 2
LI 2021b [32]	Systematic review	Effectiveness Cost-effectiveness	Transitional care	Heart failure	Mean age ranged from 59 to 79 years	RCTs	38 (not all directly relevant)	10,871	Cochrane risk of bias 2
McCurdy 2012 [26]	Health technology assessment	Effectiveness Cost-effectiveness	Hospital at home	COPD	Not reported	HTA, systematic reviews, RCTs	14	Not reported/not applicable	Cochrane criteria GRADE
Qaddoura 2015 [29]	Systematic review	Effectiveness Experience Cost-effectiveness	Hospital at home	Heart failure	Mean age 64–85 years	RCTs, observational studies	6	632	Cochrane risk of bias
Scott 2021 [39]	Systematic review	Use (indirectly relevant)	Hospital at home	Acutely ill older adults (aged >60 years) eligible for hospital at home	Where reported mean age ranged from 69 to 88 years	Cross-sectional studies, validation/agreement studies, RCT	16 (none directly relevant)	1,378	AXIS
Shepperd 2021 [18]	Cochrane systematic review	Experience Effectiveness	Hospital at home	End of life care	Mean age ranged from 63 to 74 years	RCT, cluster RCT	4	1,140	Cochrane risk of bias GRADE
Shepperd 2016 [11]	Cochrane systematic review	Effectiveness Experience Cost-effectiveness	Step up hospital at home	Adults aged over 18 years. Some studies only recruited older people	Where reported mean or median age ranged from 47 to 83 years	RCT	16	1,814	Cochrane risk of bias GRADE
Thomas 2021 [41]	Realist review	Barriers and facilitators	Remote patient monitoring interventions with clinician review of data	People with any disease condition outside of hospital where hospital use is reported	Not reported	RCTs, cohort studies, case control studies	91	Not reported	Not assessed here; previous review assessed them using Joanna Briggs Institute (JBI) checklists

(continue)

Table 1. Continued.

Review	Type of review	Questions addressed	Model assessed (authors' term)	Population inclusion criteria	Population age	Type of included studies	Number of included studies	Number of participants	Quality assessment
Thompson 2022 [42]	Rapid evidence review	Effectiveness Barriers and facilitators	Frailty care pathways and components in primary and community care	Older people with frailty	Not reported	Systematic reviews Primary studies (various designs) Not all directly relevant	11	Not reported	Evidence for Policy and Practice Information (EPPI) Centre validity assessment
Uminski 2018 [30]	Systematic review	Effectiveness Cost-effectiveness	Post-discharge (step-down) virtual wards	Heart failure or high risk chronic disease	Not reported; three studies limited to older participants (geriatric or aged >75)	RCTs	10	4,820	Cochrane risk of bias
Varney 2014 [23]	Integrative review	Effectiveness Experience Cost-effectiveness	Hospital at home (step-up)	People recruited from emergency department or community	Not reported	RCTs Observational studies Cost analysis, case controlled studies Systematic reviews, unspecified	22	Not reported	PRISMA or STROBE (these are not quality assessment tools)
Vaartio-Rajalin 2019 [38]	Scoping review	Experience Barriers and facilitators	Professional care at home (hospital at home or variants)	Adults being cared for at home by registered healthcare professionals (not primary healthcare)	Not reported/ not applicable	Studies with 'a solid methodological ground and proper descriptions of data collection and analysis'	35	Not reported/not applicable	Not applicable
Verhaegh 2014 [34]	Systematic review	Effectiveness	Transitional care interventions	Chronic illness	Not reported	RCTs (not all directly relevant)	26	7,932	Cochrane risk of bias
Vinson 2012 [27]	Systematic review	Effectiveness	Treatment without hospitalisation (step-down) including hospital in home	Pulmonary embolism	Not reported	Prospective studies: RCTs and prospective cohort studies Not all directly relevant	8	777	GRADE

People recovering from stroke and people recovering from surgery were also represented as pre-specified subgroups in Cochrane reviews, whereas many studies enrolled people with a mix of acute medical conditions [11,16].

Both step-up and step-down models of hospital at home were assessed in separate Cochrane reviews [11,16]. Step-up models of care treated patients referred from emergency departments, outpatients and primary care [11]. Although one overview of reviews looked at these two models together [21], we did not identify other comparisons of different models of treatment at home: there were no comparisons of virtual wards with traditional hospital at home, or with different approaches to virtual ward delivery. The level of multidisciplinary input in teams providing care varied; where non-acute care needs were higher, there was more nurse-led care and more family involvement in care; higher levels of acute care need were associated with involvement of a greater range of healthcare professionals [38].

Some of the reviews may be indirectly relevant to the virtual ward model of care for older people or people with frailty as an alternative to hospital admission. These reviews are mostly included as supporting evidence rather than representing the main evidence base for the findings of this overview. They are included in order to accurately reflect the breadth of the evidence base in the RES, and to reflect the congruence we identified in review findings across reviews with differing inclusion criteria. We consider the results of the RES as a whole to be relevant to older people but have excluded three reviews relating to COVID-19 from this paper, as they were not considered to relate to older people or people with frailty (Figure 1) [43–45].

Clinical-effectiveness

We looked at the following outcomes: mortality, length of stay in any hospital or hospital at home/virtual ward setting, admission or readmission to hospital following discharge from hospital at home or virtual ward, need for community support after discharge; admission to residential care, achievement of rehab goals, patient mobility, adverse events, unplanned contacts/treatment events, acceptability (to patient/carer/staff), satisfaction (patient/carer/staff). We report acceptability and patient satisfaction together with experience below. Admission to residential care was identified as an outcome after the initial plan for the RES was developed.

For this question, we drew primarily on two Cochrane reviews of step-up and step-down hospital at home care [11,16]. Supporting evidence was drawn from 14 additional Cochrane and non-Cochrane reviews, of which six were in general populations [19–24], and eight were condition-specific populations [17, 25–27, 29–32]. One of the reviews identified is a review of reviews [21] and there is additional overlap in the included studies of some of these reviews.

The Cochrane review of step-up care included 16 randomised controlled trials (RCTs) with 1814 participants [11], and the review of step-down care included 32 RCTs with 4,746 participants [16]. The judgments that the evidence was low or moderate certainty represent the GRADE assessments of the Cochrane review authors and mean that the effect estimates probably are (moderate certainty) or may be (low certainty) close to the true effects, but that further research may change the effect estimates for the outcomes and the direction of an effect [15].

There was consistent moderate or low certainty evidence from Cochrane reviews that hospital at home probably results in most clinical outcomes, including mortality, being as good or better than inpatient care, for both step-up models of admission avoidance (6-month mortality RR 0.77, 95% CI 0.60–0.99; moderate certainty evidence that there is probably a reduction) and step-down models of early discharge (3- to 6-month mortality RR 0.92, 95% CI 0.57–1.48 in people with stroke; RR 1.07, 95% CI 0.76–1.49 in mixed medical conditions; moderate certainty evidence that there is probably little or no difference) [11,16]. We particularly noted that there was probably a reduced rate of admission to residential care following treatment at home in either step-up or step-down models (step-up RR 0.35, 95% CI 0.22–0.57; step-down RR (for people with a mix of medical conditions): 0.69, 95% CI 0.48–0.99) [11,16].

There were also some potential differences in the evidence for different patient groups and between step-up and step-down models; these are explored in more detail in the full RES (see Supplementary Information in Appendix 1). The length of stay was longer in the step-up model (length of treatment mean difference 5.4 days longer (95% CI 1.9–9.0 days) [11], although shorter in the step-down model (mean differences varied in mixed medical populations but pooled estimates were 7 days shorter in stroke recovery and 4 days shorter in elective surgeries) [16]. The evidence on readmissions in particular showed inconsistency and imprecision meaning that the evidence as a whole is low certainty. For example, Cochrane authors concluded that people with COPD in particular may have reduced readmissions after hospital at home (RR 0.86, 95% CI 0.66–1.13) [16, 17, 21, 25], whereas those with a mix of acute medical conditions may have an increased risk of readmission after step-down hospital at home (RR 1.25, 95% CI 0.98–1.58) [16], but wide confidence intervals mean there is uncertainty about any true differences.

Although there was substantial evidence for mortality, length of stay and admission to residential care, we found more limited information on other outcomes.

Cost-effectiveness and costs

We looked for measures of cost-effectiveness (e.g. QALY) and relative cost-effectiveness (e.g. ICERs) but also reported cost measures. The evidence we identified relates mostly to hospital at home models and is primarily drawn from one review of 48 studies with cost analyses undertaken between 1996 and 2008 [36]. Only some of the included studies were identified as cost-effectiveness analyses, others had designs such as cost-minimisation. Supporting evidence is drawn

from seven other syntheses including a review of reviews and four Cochrane reviews [11,16,17,19,21,25,29,30]. We also checked a review of transitional care arrangements for relevant information [33]. Most of the additional evidence identified related to costs rather than to cost-effectiveness.

Most primary studies in the review of cost analyses showed estimated cost-savings from hospital at home but these estimates vary widely, ranging from savings per patient of over EUR 8,000 to increased costs of over EUR 2,000 indexed to 2018 prices [36]. Importantly, most studies used methodologies, which meant that they were likely to overestimate cost-savings. Quality assessment showed an average score of 60 out of 100 points, with almost all failing to meet one or more criteria for avoiding the risk of overestimating savings. In particular, many studies used a generic unit price for inpatient days, rather than reflecting disease or unit-specific costs or the decreasing care intensity (day-specific costs) across a stay, whereas many had a very short time-horizon that would not capture longer term outcomes. The studies in this review were undertaken in a range of different countries with diverse healthcare systems so the direct relevance of some of the data to the NHS in England is unclear. Therefore, the cost-saving potential and, to a greater extent, the cost-effectiveness of treatment at home is uncertain despite the large number of available primary studies.

A key finding was that studies disregarded costs to patients and carers. Despite 21 of 48 economic studies using the availability of informal care as an inclusion criterion, only two included costs of informal care in their analysis [36]. Studies that did consider costs to families included paid and unpaid domestic help and personal care, including the time of the informal caregiver [36]. One study estimated the mean per patient additional costs associated with informal care for COPD patients treated at home at over EUR 500 (2009 reference year) more than for those treated as inpatients in the Netherlands over a 7-day treatment period and a 3-month follow-up [46]. This pattern is supported by statements elsewhere such as the note in a 2021 review that did not include studies reported out-of-pocket costs to patients or carers [19]. The disregarding of such costs in most studies may have implications for the applicability of research to disadvantaged groups. This should be taken into account when considering the Cochrane review finding that step-up models may be less expensive than inpatient admission, excluding informal care costs [11]. (The other three Cochrane reviews all found that the evidence relating to costs—however assessed—was uncertain or weak [16–18].)

Barriers and facilitators

We considered all factors at both the patient/carer and the staff/system levels. We included barriers to and facilitators of setting up virtual wards/hospital at home as well as to enrolment in them. We were particularly interested in patient-level factors with implications for equity such as digital literacy. In answering this question, we drew heavily on a recent meta-synthesis of 16 studies on the perspective of stakeholders using hospital at home models [37], and on a recent realist review of 91 studies of remote monitoring interventions [41]. We recognise that evidence from remote monitoring may sometimes not be directly relevant to virtual wards or hospital at home. We also drew supporting information from a review of reviews [21].

Organisational and interventional

Many of the barriers to remote monitoring related to organisational or team characteristics, including the lack of guidance on team characteristics, data governance and organisational oversight. Identification of the appropriate clinical outcomes for patient monitoring was also identified as a concern by staff [41]. Facilitators at the organisational level related to supportive operational, regulatory and legal frameworks, co-ordination and integration of care, including with post-discharge care, and staff with strong clinical and communication skills [21, 37, 41].

Interventions that were tailored to patient conditions and situations were associated with successful implementation. Having patient involvement in the design of remote monitoring interventions was identified as a factor in their success. Making the intervention simple and easy to use; ensuring accurate and sensitive measurements; using patient-specific measurements; and co-ordinating the intervention with self-management (e.g. monitoring of medication adherence), combined with support, education and feedback, to personalise care were also considered important to success [41].

Interpersonal and intrapersonal

Many of the facilitators identified related to patient characteristics. Patients were selected for factors such as strong social support, positive health behaviors, confidence in receiving care at home and conducive home environment [37]. Barriers to implementation included greater physical distance of patients' homes to the hospital, medical condition stability and level of disability [21]. Issues around health and technological literacy and access to internet or internet-enabled devices were identified as barriers; use of telephone-based monitoring was considered to be more inclusive for some patients. The fact that patient characteristics were so strongly identified as both barriers and facilitators may indicate that careful consideration of patients' characteristics before enrolment is important for the successful use of virtual wards. It also suggests that there may be limits to the applicability of virtual wards to some groups of patients. Much of the evidence here comes from remote monitoring studies and may therefore be only indirectly relevant to hospital at home and virtual wards.

We noted that some of these themes were developed in excluded reviews of remote monitoring for COVID-19, where equity-related factors were the largest group of barriers, the most commonly identified of these was the place of residence, including rural or remote residence,

nursing home residence or homelessness [45], whereas patient and carer training was associated with successful remote monitoring [44].

Staff and patient experience

We looked at all measures of patient or carer experience, satisfaction and acceptability. We also report staff experience. We drew primarily on a recent high-quality meta-synthesis of 16 qualitative or mixed methods studies of hospital at home [37], supported by the findings of a scoping review on patient-centredness in care outside hospitals [38], and information on patient satisfaction from five intervention reviews in hospital at home [11,16,18,22,29].

In mixed methods and qualitative studies, expressed satisfaction with hospital at home is generally high among both patients and staff involved in delivery [37]. Patient satisfaction in reviews of RCTs may be slightly higher in those treated in hospital at home compared with those treated as inpatients, although some studies find no difference [11,16].

A recent review of qualitative studies found that the decision to have care at home was often determined by the preferences of healthcare professionals and patients, with less consideration given to the views of carers or families. Caregiver burden was, however, a theme in many of the identified studies, particularly where patients had dementia or mental illness; some caregivers were described as having 'burnt out' during hospital at home [37]. Carer outcomes in intervention studies may not reflect these perspectives, with some reporting reduced stress [16].

Advantages, disadvantages and challenges identified in the perspectives of both staff and patients [37] reflected elements also identified as influencing the success of remote monitoring interventions [41]. The need to consider the experience of informal carers was particularly highlighted in this meta-synthesis [37].

Discussion

Strengths and limitations of this work

This systematic search identified a substantive body of existing evidence syntheses relevant to the area. However, the methods used are not those of a full systematic review; they are an adaptation of methods designed to provide a very rapid summary of the evidence to support local decision-making and planning around innovation implementation, and to inform further evaluation. Primary research is likely to exist, which would fill in gaps, or complement the evidence identified here. Many of the included reviews are recent; nevertheless. primary research published after the search dates of the reviews is not represented in this synthesis.

Because of the breadth of our original RES, some of the reviews included here may be considered indirectly relevant to care of older people or people with frailty as an alternative to hospital admission. These reviews are mostly included as supporting evidence rather than representing the main evidence base for the findings of this overview. It is also the case that many of the reviews will have some included studies that are also indirectly relevant to the population of older people or people with frailty.

The representativeness of the populations included in trials or other primary research studies varies, meaning that systematic reviews may not be fully reflective of people treated in virtual wards in routine practice; the RES may therefore not fully reflect clinical practice, particularly at a time of rapid service evolution.

There is a more developed evidence base, especially in terms of clinical effectiveness, for hospital at home than for virtual wards; because the service model has been in use for a longer period of time, there are many more trials and more systematic reviews. The evidence for the broader area of remote monitoring is also wider than virtual ward use and therefore may not be directly relevant to consideration of virtual wards.

Implications for research and practice

This rapid synthesis identified that although there is a substantive evidence base for hospital at home, there is a need for robust evaluation of virtual ward models of care, given the rapid expansion of their use following COVID-19.

There is lack of guidance for key aspects of virtual ward provision—including team characteristics, outcome selection and data protection. This suggests that development and dissemination of evidence-based guidance for service delivery is a priority. With regards to frailty, there will be significant implications for workforce design to support hospital at home service development, and how technology might be helpfully utilised. Distinctions might also helpfully be made in service modeling and data collation between prevention of deterioration and management of long-term conditions, for example, in the context of heart failure, versus management of acute deterioration.

The role of family and other informal carers is likely to be key to the successful implementation, due to services being frequently used by people who have existing care needs prior to acute illness. Carer burden and the risk of carer burnout were identified as key considerations but there is little evaluation of the impact, including the financial impact, on carers. Evaluations of virtual wards should include carer outcomes and experiences as a priority. Evaluations should also include rigorous assessments of cost-effectiveness as well as clinical effectiveness, which should include direct and indirect costs to patients, carers and families. Existing evidence suggests that clinical outcomes for hospital at home are largely comparable to those of inpatient care, albeit with some variation in readmissions and length of stay between patient groups and models of care. The evaluation of virtual wards that share many features with hospital at home may therefore need to prioritise the other questions addressed here, of cost-effectiveness, barriers to implementation, and patient and carer experiences.

Research in this area is evolving rapidly with rigorous primary studies becoming available [47, 48], ensuring that the implementation of services is informed by evidence is a priority. Those developing and implementing virtual ward

services should be aware of the research on barriers and facilitators and should consider both organisational/interventional and patient-level factors. Approaches such as living systematic reviews (reviews that are continuously updated) may prove useful in ensuring that practice is informed by a rapidly developing evidence base.

Concluding remarks

The development of virtual wards and hospital at home is rapidly evolving. This RES summarises some of the key considerations in service development. It also highlights where evidence is lacking and the importance of building robust evaluation into new models. There is a substantial evaluation opportunity given implementation at scale. Rapid evaluations, potentially using routine data, are likely to be informative in initial assessments of the impact of these changes on service provision. The importance of co-production and co-design with service users is emphasised as well as impact, financial and otherwise, on unpaid carers. With regards to older people and people with frailty, specific attention should be paid to inclusivity of services for people with dementia so that older people are not disadvantaged, in terms of either the quality of care or through digital exclusion.

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Data Availability Statement: This is a review of previously published studies, therefore all the data used in the review are already in the public domain. All data relevant to the included studies are included in the article or uploaded as supplementary information. A list of studies excluded at full text is available on reasonable request.

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