

SUPPLEMENTARY INFORMATION

Table 1: PICO TABLE

Population/problem	Intervention	Comparator	Outcomes
People over 65 (elderly)	Virtual wards Virtual hospital (Inpatient OR hospital) level care at home (Early discharge/Admission avoidance) hospital at home step-up (hospital admission avoidance) step-down (early discharge from hospital) Remote monitoring Telemonitoring NHS@Home Hospital@Home	Traditional care settings	The efficiency of care – disruption of an existing care package, reliability of care delivered through virtual wards to meet the patient’s needs. Safety of care – All patient safety outcomes and benefits of virtual wards, including • Mortality • Admissions and readmissions • Length of stay • Patient experience of the safety of care delivered through virtual wards • Patient and carers’ burden and experience • Loss of independence • Deconditioning • Safeguarding concerns • Datix reports/incident reports • Infection control concerns

Table 2: Results based on Safety Engineering Initiative for Patient Safety (SEIPS 3.0) Model

SEIPS 3.0 Domain	Key findings (Summary)	References
Persons (Healthcare professionals)	Multidisciplinary teams deliver Hospital-at-Home care, varying widely by country and model. U.S models include general internists, RNs, physician assistants, and allied health professionals, often via private partners. UK and European models involve district nurses, geriatricians, therapists, and coordinators. Variability in team composition and leadership reflects different governance structures and service priorities.	(1-11)
Persons (Patients)	Hospital-at-Home patients were typically frail, with acute yet stable conditions suitable for home management. Most were transferred from hospital, though some services included rehabilitation, chronic complex, or palliative patients.	(1-4, 6-14)
Tasks	Core Hospital-at-Home tasks included parenteral medication administration, vital sign monitoring, venepuncture, oxygen therapy, diagnostics, prescribing, and documentation. Some models added palliative, nutritional, or rehabilitative care. Task delegation and leadership varied; geriatricians often led CGA-guided models, while physicians or GPs provided medical oversight	(1-9, 11-13)

Tools and Technology	Tools included cannulas, central venous access devices, oxygen cylinders, thermometers, and BP monitors. Technology integration ranged from basic communication (phones, SMS) to advanced telehealth, wearable fall-detection sensors, and encrypted video consultations.	(3, 4, 6-10, 13, 14)
Organisation	Organisational models varied widely: some offered 24 hours physician availability, while others had limited-service hours. Admission criteria, discharge protocols, and referral processes differed. Integrations with external partners (private nursing agencies, diagnostics) was common. Leadership ranged from geriatrician-to GP-led, with differences in staffing ratios and patient caps.	(1-11, 13, 14)
Internal environment	Patients were excluded if homes lacked basic amenities (water, electricity, heating) or had physical hazards (e.g., steep stairs, unsafe layouts).	(1, 3, 8, 11, 12)
External environment	Limitations in diagnostic capacity (CT, MRI, endoscopy) required hospital visits. Resource constraints restricted 24-hour nursing coverage and capped patient numbers. Partnerships with home health agencies supplied staff, equipment, and therapies.	(4, 10, 13)

Processes of care	Processes included clinical assessment, prescribing, medication administration, home visits, discharge planning and follow-up care. Integration of rehabilitation and radiologic support varied, reflecting service focus and resource availability.	(3, 4, 6-10, 12)
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Table 3: Results based on the Yorkshire Contributory Factor Framework

YCFF Domain	Key findings (summary)	References
Domain 1: Situational Factors	Patient Factors: Patient admitted to Hospital-at-Home commonly presented with multimorbidity, frailty, chronic complex conditions or poor functional status. They were admitted from hospitals, nursing homes, or for palliative and rehabilitation care.	(2-4, 6-14)
	Task characteristics: Hospital-at-Home services primarily delivered acute clinical interventions such as parenteral medication, vital sign monitoring, diagnostics, and assessment. However, advanced diagnostics and continuous telemetry were often not feasible at home.	(3, 4, 6-10, 12, 13)
	Individual staff factors: Staff training and professional experience were inconsistently reported. Physicians,	(3-10, 12-14)

	consultants, and geriatricians often held primary medical responsibility. Only one study specified training and the duration of training.	
Domain 2: Local Working Conditions	Staffing workloads were inconsistently reported. Some models implemented one-to-one supervision for initial care, while others capped patient caseloads (e.g., less than 12 for orthopaedic cases). Staffing limitations, restricted bed capacity, and dependence on structured care pathways influenced care quality and safety. Standardised admission and discharge criteria improved safety and consistency.	(1-4, 6-14)
Domain 3: Organisational factors	Physical environment: Managing conditions such as delirium was more challenging at home due to lack of containment and clinical infrastructure. Unpredictable layouts and limited space hindered monitoring and safety. Despite these challenges, patients reported high satisfaction, citing comfort, privacy, and maintenance of normal routines as benefits.	(6, 8-10)
	Staff training and Education: Only one study described staff training in detail. Hospital-at-Home staff completed a one-day intensive training followed by shadowing experienced home-based physicians.	(6)

Domain 5: Communication and Culture	Communication systems were inconsistently described. Reported issues included delayed initiation of care, unclear contact pathways, and poor information sharing. Some models mitigated these issues through digital tools (telephone, encrypted video, SMS) and hotline systems to improve accessibility and responsiveness	(5, 6, 8)
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Table 4: Search Strategy

Databases and search engines: MEDLINE, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Google Scholar, Embase.

S1	MH "Home Care Services, Hospital Based"
S2	MH "Telemedicine+"
S3	Virtual ward*
S4	"Remote monitor*"
S5	telemedicine
S6	Telehealth
S7	"hospital at home or hospital in the home or hith or Hospital-at-Home"
S8	"Virtual hospital*"
S9	"Care at home"
S10	NHS@Home
S11	"NHS at Home"
S12	"Step up care"
S13	"Step down care"

S14	"hospital admission avoidance"
S15	"early discharge from hospital"
S16	(MH "Aged, 80 and over") OR (MH "Aged+")
S17	Elderly or aged or older or elder or geriatric or old people or senior
S18	S16 OR S17
S19	S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8 OR S9 OR S10 OR S11 OR S12 OR S13 OR S14 OR S15
S20	MH "Patient Harm") OR (MH "Patient Safety")
21	(MH "Length of stay")
22	"length of stay"
23	"incident report"
24	(MH "Patient Readmission") OR "patient readmission"
25	"readmission rate"
26	(MH "Medical Errors")
27	"infection rate*" or "infection control" or "infection prevention"
28	"benefit* of care at home"
29	"deconditioning"
30	"medical error"
31	(MH "Mortality") OR (MH "Morbidity")
32	"loss of independence"
33	(MH "Sepsis")
34	Sepsis
35	mortality

36	morbidity
37	"patient safety"
38	"patient harm"
39	S20 OR S21 OR S22 OR S23 OR S24 OR S25 OR S26 OR S27 OR S28 OR S29 OR S30 OR S31 OR S32 OR S33 OR S34 OR S35 OR S36 OR S37 OR S38
40	S18 AND S19 AND S39

Table 5: Quality Assessment using the QuADS tool

Study reference															
Shepperd,Sasha;Craddock, Bamford,Andrea;Butler,Christopher;Ellis,Graham;Godfrey,Mar y;Gray,Alastair;Hemsley,Anthony;Khanna,Pradeep;Langhorne,P eter;Mäkelä,Petra:HospitalatHomeadmissionavoidancewithco mprehensivegeriatricassessmenttomaintainlivingathomeforpe opleaged65yearsandover:aRCT HealthandSocialCareDeliveryResearch2022;10(2):1-1242022	1	3	3	3	3	3	2	2	1	2	3	2	2		
Levine, D. M.; Pian, J.; Mahendrakumar, K.; Saenz, A.; Schnipper, J. L.Hospital-level care at home for acutely ill adults: A qualitative evaluation of a randomized controlled trial. Journal of General Internal Medicine 2019;34(2):S241-S242 2019	0	1	2	3	0	2	0	0	0	0	0	1	2		
Tierney, B.; Todd, S.; Melby, V (2022) Service evaluation comparing acute care at home for older people and	0	3	1	1	0	1	1	1	0	1	1	0	1		

conventional acute hospital care of the elderly ward. Age and Ageing 2022;51():iii10															
Caplan, G. A.; Ward, J. A.; Brennan, N. J.; Coconis, J.; Board, N.; Brown, A. Hospital in the home: a randomised controlled trial. The Medical journal of Australia 1999;170(4):156-160.	0	1	2	3	2	1	0	1	1	0	1	0	1		
Shepperd, S.; Butler, C.; Craddock-Bamford, A.; Ellis, G.; Gray, A.; Hemsley, A.; Khanna, P.; Langhorne, P.; Mort, S.; Ramsay, S.; Schiff, R.; Stott, D. J.; Wilkinson, A.; Yu, L. M.; Young, J. Is comprehensive geriatric assessment admission avoidance hospital at home an alternative to hospital admission for older persons? A randomized trial. Annals of Internal Medicine 2021;174(7):889-898 2021	0	1	1	1	1	1	0	1	1	1	1	1	1	2	
Tsiachristas, Apostolos; Ellis, Graham; Buchanan, Scott; Langhorne, Peter; Stott, David J.; Shepperd, Sasha. Should I stay or should I go? A retrospective propensity score-matched analysis using administrative data of hospital-at-home for older people in Scotland. BMJ open 2019;9(5):e023350 2019	0	1	3	1	1	1	0	1	1	2	1	0	2		
Leff, B.; Burton, L.; Mader, S. L.; Naughton, B.; Burl, J.; Inouye, S. K.; Greenough, W. B., III; Guido, S.; Langston, C.; Frick, K. D.; Steinwachs, D.; Burton, J. R.; Leff, Bruce; Burton, Lynda; Mader, Scott L.; Naughton, Bruce; Burl, Jeffrey; Inouye, Sharon K.; Greenough, William B., 3rd; Guido, Susan. Hospital at home: feasibility and outcomes of a program to provide	0	3	2	2	1	1	0	1	2	1	1	1	2		

hospital-level care at home for acutely ill older patients. <i>Annals of Internal Medicine</i> 2005;143(11):798-56 2005															
Leff, B.; Burton, L.; Guido, S.; Greenough, W. B.; Steinwachs, D.; Burton, J. R. Home hospital program: a pilot study. <i>Journal of the American Geriatrics Society</i> 1999;():697-702 1999	0	1	1	1	1	0	0	2	0	1	1	0	2		
Leung, Doris Y. P.; Lee, Diana Tze-Fan; Lee, Iris F. K.; Lam, Lai-Wah; Lee, Susanna W. Y.; Chan, May W. M.; Lam, Yin-Ming; Leung, Siu-Hung; Chiu, Pui-Chi; Ho, Nelly K. F.; Ip, Ming-Fai; Hui, May M. Y. The effect of a virtual ward program on emergency services utilization and quality of life in frail elderly patients after discharge: a pilot study. <i>Clinical interventions in aging</i> 2015;10():413-420 2015	0	1	2	1	1	0	1	1	3	0	1	0	2		
de Stampa, Matthieu; Georges, Alexandre; Grino, Michel; Cerase, Valerie; Baudouin, Édouard; Vedel, Isabelle. Thirty-day hospital readmission predictors in older patients receiving hospital-at-home: a 3-year retrospective study in France. <i>BMJ open</i> 2023;13(12):e073804 2023	0	3	2	1	0	0	1	0	0	0	1	0	2		
Richards, S. H.; Coast, J.; Gunnell, D. J.; Peters, T. J.; Pounsford, J.; Darlow, M. A. Randomised controlled trial comparing effectiveness and acceptability of an early discharge, hospital at home scheme with acute hospital care. <i>BMJ (Clinical</i>	0	1	1	1	1	1	1	1	1	2	1	0	1		

research ed.) 1998;316(7147):1796-1801															
1998															
Caplan, G. A.; Coconis, J.; Woods, J.; Caplan, Gideon A.; Coconis, Janis; Woods, Jan. Effect of hospital in the home treatment on physical and cognitive function: a randomized controlled trial. Journals of Gerontology Series A: Biological Sciences & Medical Sciences 2005;60(8):1035-1038. 2005	1	1	2	1	1	2	1	1	1	2	1	0	1		
Ko, Stephanie Q.; Goh, Joel; Tay, Yee Kian; Nashi, Norshima; Hooi, Benjamin M. Y.; Luo, Nan; Kuan, Win Sen; Soong, John T. Y.; Chan, Derek; Lai, Yi Feng; Lim, Yee Wei Treating acutely ill patients at home: Data from Singapore. Annals of the Academy of Medicine, Singapore 2022;51(7):392-399.	0	1	2	1	0	1	1	0	2	1	1	0	1		
Wilson, A.; Parker, H.; Wynn, A.; Jagger, C.; Spiers, N.; Jones, J.; Parker, G. Randomised controlled trial of effectiveness of Leicester hospital at home scheme compared with hospital care. BMJ (Clinical research ed.) 1999;319(7224):1542-1546 1999	0	1	1	1	1	1	0	0	1	1	1	0	1		

Table 6: Key for QuADS' tool assessment

S/N	QuADS Criteria
1	Theoretical or conceptual underpinning to the research
2	Statement of research/aims
3	Clear description of research setting and target population
4	The study design is appropriate to address the stated research aims
5	Appropriate sampling to address the research aims
6	Rationale for choice of data collection tool(s)
7	The format and content of data collection tool is appropriate to address the stated research aim/s
8	Description of data collection procedure
9	Recruitment data provided
10	Justification for analytic method selected
11	The method of analysis was appropriate to answer the research aim/s
12	Evidence that the research stakeholders have been considered in research design or conduct
13	Strength and limitations critically discussed

References:

1. Richards SH, Coast J, Gunnell DJ, Peters TJ, Pounsford J, Darlow MA. Randomised controlled trial comparing effectiveness and acceptability of an early discharge, hospital at home scheme with acute hospital care. *BMJ (Clinical research ed)*. 1998;316(7147):1796-801.
2. Wilson A, Parker H, Wynn A, Jagger C, Spiers N, Jones J, et al. Randomised controlled trial of effectiveness of Leicester hospital at home scheme compared with hospital care. *BMJ (Clinical research ed)*. 1999;319(7224):1542-6.
3. Caplan GA, Coconis J, Woods J, Caplan GA, Coconis J, Woods J. Effect of hospital in the home treatment on physical and cognitive function: a randomized controlled trial. *Journals of Gerontology Series A: Biological Sciences & Medical Sciences*. 2005;60(8):1035-8.
4. Leff B, Burton L, Mader SL, Naughton B, Burl J, Inouye SK, et al. Hospital at home: feasibility and outcomes of a program to provide hospital-level care at home for acutely ill older patients. *Annals of Internal Medicine*. 2005;143(11):798-56.
5. Leung DYP, Lee DTF, Lee IFK, Lam LW, Lee SWY, Chan MWM, et al. The effect of a virtual ward program on emergency services utilization and quality of life in frail elderly patients after discharge: A pilot study. *Clinical interventions in aging*. 2015;10:413-20.
6. Levine DM, Pian J, Mahendrakumar K, Saenz A, Schnipper JL. Hospital-level care at home for acutely ill adults: A qualitative evaluation of a randomized controlled trial. *Journal of General Internal Medicine*. 2019;34(2):S241-S2.
7. Tsiachristas A, Ellis G, Buchanan S, Langhorne P, Stott DJ, Shepperd S. Should I stay or should I go? A retrospective propensity score-matched analysis using administrative data of hospital-at-home for older people in Scotland. *BMJ open*. 2019;9(5):e023350.

8. Shepperd S, Butler C, Craddock-Bamford A, Ellis G, Gray A, Hemsley A, et al. Is comprehensive geriatric assessment admission avoidance hospital at home an alternative to hospital admission for older persons? A randomized trial. *Annals of Internal Medicine*. 2021;174(7):889-98.
9. Shepperd S, Craddock-Bamford A, Butler C, Ellis G, Godfrey M, Gray A, et al. Hospital at Home admission avoidance with comprehensive geriatric assessment to maintain living at home for people aged 65 years and over: a RCT. *Health and Social Care Delivery Research*. 2022;10(2):1-124.
10. Ko SQ, Goh J, Tay YK, Nashi N, Hooi BMY, Luo N, et al. Treating acutely ill patients at home: Data from Singapore. *Annals of the Academy of Medicine, Singapore*. 2022;51(7):392-9.
11. de Stampa M, Georges A, Grino M, Cerase V, Baudouin É, Vedel I. Thirty-day hospital readmission predictors in older patients receiving hospital-at-home: a 3-year retrospective study in France. *BMJ open*. 2023;13(12):e073804.
12. Caplan GA, Ward JA, Brennan NJ, Coconis J, Board N, Brown A. Hospital in the home: a randomised controlled trial. *The Medical journal of Australia*. 1999;170(4):156-60.
13. Leff B, Burton L, Guido S, Greenough WB, Steinwachs D, Burton JR. Home hospital program: a pilot study. *Journal of the American Geriatrics Society*. 1999:697-702.
14. Tierney B, Todd S, Melby V. SERVICE EVALUATION COMPARING ACUTE CARE AT HOME FOR OLDER PEOPLE SERVICE AND CONVENTIONAL ACUTE HOSPITAL CARE OF THE ELDERLY WARD. *Age and Ageing*. 2022;51:iii10.