

# IDENTIFYING POTENTIAL POPULATIONS FOR HOME HOSPITALISATION

A SCOPING REVIEW OF THE LITERATURE TO SUPPORT THE REVIEW OF  
THE SOUTH AUSTRALIAN MY HOME HOSPITAL SERVICE



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# IDENTIFYING POTENTIAL POPULATIONS FOR HOME HOSPITALISATION

## EXECUTIVE SUMMARY

Home hospitalisation services provide acute and sub-acute care for a patient in their own residence for conditions that would normally require admission to a traditional hospital. Such services can substitute traditional inpatient admission, utilising specialised technologies, skills, and supports.

My Home Hospital (MyHH) is an SA Health service delivered by a contracted service provider. The existing target populations of the MyHH service consist of twelve (12) different three-character Adjacent Diagnosis Related Groups (ADRGs), each of which can comprise up to four different four-character DRGs that represent different levels of patient complexity within that set.

To support the review and continual improvement of the MyHH in South Australia, the Flinders Health and Medical Research Institute (FHMRI) were commissioned by Wellbeing SA to conduct a scoping review of the recent literature since 2017, to identify novel populations for whom HITH services have been provided elsewhere, and who may represent people within South Australia who may also benefit from MyHH access into the future.

Observational studies and trialled models from the international and Australian literature are presented in this report, to firstly chart out the different targeted populations, before then summarising the evidence and providing insights for future extensions of the service, and diversification of home hospitalisation in South Australia.

Drawing upon the activity observed within Australia – three ADRGs are proposed as ‘High Proportion Services’ which are not currently within the scope of the MyHH, including septic arthritis; digestive malignancy; and infective endocarditis. Potential additionally relevant ‘High Volume Services’ were seen in digestive malignancy; miscellaneous musculoskeletal procedures for infection or inflammation of bone and joint; sleep apnoea; and septicaemia. ‘Other Targets’ from the Australian activity worth noting were also those for other digestive system disorders and septicaemia.

The trialled models that emerged, having also not been observed within the present national activity data, included those for dehydration and electrolyte imbalances; falls, frailty, and functional decline; delirium; and asthma exacerbation.

While beyond the current targets of the configuration of the MyHH service in SA, the review also highlighted future diversification considerations in post-surgery early supported discharge; children’s services; palliative care; mental health; and rural and remote services.

The insights provided here are based on observed HITH activity across Australia and the development of novel service delivery models, published within the international literature. To prioritise between these options, further local evidence can be used to profile the expected costs and effects of different options, relative to each other.

## CONTENTS

Background .....	5
Existing HITH services within MyHH .....	6
Existing Target Populations of MyHH .....	6
Review Focus.....	7
Literature Review Approach .....	7
Defining and Aligning the Research Question .....	8
Developing and Aligning the Inclusion Criteria.....	8
Describing the Planned Approach.....	8
Searching the Evidence .....	8
Selecting the Evidence .....	9
Extracting the Evidence.....	9
Analysis of the Evidence .....	9
Presentation of The Results .....	11
International Observational Studies of HITH Activity .....	11
Australian Observational Studies of HITH Activity.....	14
Trialled Models and Population-Specific Case Studies .....	17
Dehydration and electrolyte imbalances.....	17
Falls, frailty, and functional decline .....	17
Delirium.....	17
Asthma exacerbation .....	17
Summarising the Evidence - Insights for MyHH in South Australia .....	18
Triangulation of evidence .....	18
Options for Service Extension .....	19
From activity observed across Australia .....	19

From trialled models and population-specific case studies.....	20
Options for System Diversification.....	21
Concluding Comments .....	24
Appendix 1 – Included Studies .....	25
References.....	34

## LIST OF TABLES

Table 1 – Initial Targeted Populations for the My Home Hospital Service .....	6
Table 2 – Scottish NHS Patient Characteristics at Index Admission by HITH or Usual Care for Older People, as taken from Tsiachristas, Ellis [15] .....	11
Table 3 – HITH Activity Volumes by Diagnostic Group for Catalonia (SPAIN) in 2014, as taken from Arias-de la Torre, Zioga [41].....	12
Table 4 – Mount Sinai (USA) Patient Characteristics by HITH or Usual Care, as taken from Federman, Soones [42] .....	13
Table 5 – Profile of Queensland Target Populations for HITH with 2017 Activity Volumes, based on Kivic and Hines [37] .....	14
Table 6 –Australian National Profile of HITH related Activity for 2011 to 2017, as taken from Montalto, McElduff [5].....	15
Table 7 – ADRGs of Potential Additional Target Populations for MyHH-type Services .....	23
Table 8 – Table of Included Studies .....	25

## LIST OF FIGURES

Figure 1 – Scope of this review .....	7
Figure 2 – PRISMA Flow Diagram .....	10
Figure 3 - Triangulating Observational Study Evidence .....	18

## BACKGROUND

Home hospitalisation services provide acute and sub-acute care for a patient in their own residence for conditions that would normally require admission to a traditional hospital. Such services can substitute traditional inpatient admission, utilising specialised technologies, skills, and support.

The first models of “home care” are thought to have emerged in New York USA during the 1940s, to facilitate a range of medical, social, and housekeeping services, together with occupation and physical therapies [1]. There were also widespread use of hospital at home services within the south of France during the 1950s, which were translated into the UK National Health Service during the 1970s [2] and Spain in the 1990s [3].

Hospital in the Home (HITH) programs have been in place in Australia since the mid-1990s, and by 2008-09 were delivering care for approximately 5% of all inpatient bed days in Victoria – providing care that was equivalent to a 500-bed traditional hospital [4]. The Victorian model of equivalent funding for HITH as a traditional inpatient admission has supported its adoption in most Australian states [5]. During the 2010s, explicit guidelines on the organisation and delivery of HITH had been produced by state governments including NSW [6], QLD [7] and VIC [8]. The amount of hospital care delivered as HITH in Australia is currently increasing at a rate that is twice that of traditional care [5].

Different models of HITH are used in Australia, including unitary systems of care (all medical and nursing care, delivered by a single service) to matrix models (separate provider organisations delivering different components in a coordinated manner) [9]. There is continued scope for further uptake and expansion of HITH as clinician confidence, technology and the quality of the patient experience improve [5, 9]. Enhanced research evidence about safety, effectiveness and cost-effectiveness will enhance clinician confidence and improve uptake.

Common considerations when appraising the value of HITH models and whether they are worthwhile include (i) if they are substitutive or additive to hospital-based admitted care; (ii) downstream effects on health status and service utilisation; (iii) the extent of relative cost differences between hospital and home

settings for care provision; and (iv) the benefits associated with improved quality-of-life and experience of patients and informal carers that may offset any additional costs [10].

Existing economic evaluations of HITH in Australia have been calculated based on an equivalency (at least non-inferiority) of clinical outcomes, and have reported that the overall HITH costs are 22% less than those accrued through hospital-based care [11]. When looking through the savings for specific diagnosis related groups (DRGs); however, these are dependent upon the extent to which HITH care reduces inpatient hospital stays with their higher unit or per diem cost, relative to any increase in the total treatment period [12].

This was recently supported by a large, multi-site randomized clinical trial (RCT) of HITH programmes within the UK National Health Service [13], of which the accompanying economic evaluation empirically observed an equivalency of outcomes and significant cost-savings [14]. Ultimately, whether HITH services lead to higher or lower costs is determined by the staffing models that deliver care within the different types of ‘beds’ [15].

Economic benefits are not an achievement of the formal health system alone, however. Improvements associated with HITH are also dependent upon contributions from patients and their informal caregivers, themselves. It has been found, at least within the UK example, that a significant role is often still played by non-professionals, who help navigate disjointed intersections between hospital-based and home-based admitted-level care [16].

The pursuit of value-based and sustainable healthcare provision is a policy driver of HITH programmes, internationally. HITH systems of the future will ideally be characterised by high-quality, technology-enabled services that are seamlessly integrated around the needs and preferences of patients and their caregivers [17]. In addition to being a technology-enabled solution, HITH also requires a number of social transformations to ways of working in healthcare [18]. Satisfied workforces work within home care organisations across the world but may require new skills training and payment structures to implement new services with a high-level of fidelity to future expectations.

## EXISTING HITH SERVICES WITHIN MYHH

My Home Hospital (MyHH) is an SA Health service delivered by a contracted service provider. MyHH is a HITH service, which provides the equivalent of in-patient acute hospital care in a patient's own home. MyHH commenced in January 2021 and is available to people residing in the Adelaide metropolitan and some “peri-urban” areas including the Mount Barker and Gawler areas. At commencement, MyHH services were available to a first tranche of five clinical conditions; a second tranche was introduced in July 2021 to include a further seven target conditions and consider conditions that may be safe and appropriate for in-home hospital care. Some of the features of MyHH include the provision of diagnostic and pathology services (some x-rays and blood tests), medication and other support services such as meals and personal care if necessary; and equipment, monitoring and home oxygen services. It is a public hospital service and is available at no cost to eligible patients. To be eligible for MyHH, a patient must:

- Require public hospital inpatient care for which home based hospital care is safe and appropriate,
- Live in one of the service areas,
- Be referred by a GP, specialist, nurse practitioner, emergency department, hospital or ambulance,
- Be eligible for Medicare and not have funding through the Department of Veteran’s Affairs, WorkCover or third-party insurance,
- Have access to a mobile phone or landline to make/receive phone calls,
- Have a safe home environment, and
- Consent to receive MyHH care.

HITH, Hospital at Home (HaH) and virtual hospitals are types of intermediate care [19, 20]. These are commonly categorized under the goals of (i) early supported discharge (ESD), (ii) hospital/admission avoidance (HA), and (iii) a combination of ESD and HA [21-23]. End-of-life care (iv) is an additional, emerging focus [24]. HITH does not necessarily need to be about ‘hospital avoidance’ per se, and instead can be thought of as ‘hospital substitution’. This delineation emphasises that access to hospital-type care is still provided, at a level that is commensurate with ward-based delivery; it is the costs and patient risks-of-harm associated with

the physical location that are avoided. Given this, we frame the concept of types of HITH and HaH from a patient journey perspective of receiving a referral for intermediate care through previous primary or community care; and transitioning from emergency department and inpatient settings to one that is closer to home.

## EXISTING TARGET POPULATIONS OF MYHH

The existing target populations of the MyHH service consist of twelve (12) different three-character Adjacent Diagnosis Related Groups (ADRGs), each of which can comprise several different four-character DRGs that represent different levels of patient complexity within that set. The twelve target MyHH ADRGs introduced across two tranches are listed in *Table 1*, noting a far broader range of conditions may be eligible, underlining the rationale for this literature review.

TABLE 1 – INITIAL TARGETED POPULATIONS FOR THE MY HOME HOSPITAL SERVICE

ADRG Code	ADRG Description	Delivery Stage
J64	Cellulitis	Tranche 1
E62	Respiratory Infections/Inflammations	Tranche 1
L63	Kidney and urinary tract infections	Tranche 1
E65	Chronic obstructive airways disease	Tranche 1
F63	Venous Thrombosis	Tranche 1
R61	Lymphoma and non-acute leukaemia	Tranche 2
F62	Heart failure and shock	Tranche 2
F74	Chest pain	Tranche 2
J63	Non-Malignant Breast Disorder	Tranche 2
E61	Pulmonary embolism	Tranche 2
I73	Aftercare of Musculoskeletal Implants or Prostheses	Tranche 2
I64	Osteomyelitis	Tranche 2

## REVIEW FOCUS

To support the evaluation and continual improvement of the MyHH in South Australia, the Flinders Health and Medical Research Institute (FHMRI) were commissioned by Wellbeing SA to conduct a review of the recent literature since 2017, to identify novel populations for whom HITH services have been provided elsewhere, and who may represent people within South Australia who may also benefit from MyHH access into the future. This is visualised in *Figure 1*, whereby the review focus of ‘Informing Service Extension’ is highlighted in dark orange in the upper right quadrant. Some new and additional target populations may require diversification of the MyHH services, and so the modes of service configuration and delivery were also considered, as per the bottom right quadrant in *Figure 1*.

Neither existing or potential new MyHH services for the existing targeted populations included *Table 1*, were a focus of this review, and these were ruled out of scope. These are also depicted in *Figure 1*, as the grey column on the left-hand side. Future reviews and market analyses may further be conducted to confirm and inform the improvement of the existing configuration of MyHH services, targeted at those populations already defined; or inform the development of new service configurations for these same people.

## LITERATURE REVIEW APPROACH

Using the approach by Peters, Marnie [25] this scoping review consisted of nine steps: (1) defining and aligning the objectives and questions; (2) developing and aligning the inclusion criteria with the objectives and questions; (3) describing the planned approach; (4) searching the evidence; (5) selecting the evidence; (6) extracting the evidence; (7) analysis of the evidence; (8) presentation of the results; and (9) summarizing the evidence in relation to the purpose of the review, making conclusions, and noting any implication of the findings.

An initial limited search highlighted that the topic of home-delivered hospital-level care is already well researched, with numerous observational, trial and review studies published. While not a comprehensive list, there are examples of relevant scoping reviews of HITH in general [26], or targeting children [27] and

older adults [28]. Other evidence-based resources include systematic reviews [3], reviews of observational studies [29], a 2012 meta-analyses on ‘hospital in the home’ [30], an integrative Joanna Briggs Institute (JBI) review [31], realist reviews of the theories behind the effects of intermediate care [19, 20], a suite of Cochrane reviews of the evidence [21, 22, 24], and a qualitative evidence synthesis on factors influencing the implementation of HITH [23]. There have also been a two recent umbrella reviews of reviews [32, 33].

	Existing MyHH Population	New MyHH Population
Existing MyHH Configuration	<p style="text-align: center;"><b>Informing Service Improvement</b> (Out of scope)</p>	<p style="text-align: center;"><b>Informing Service Extension</b> (Review focus)</p>
New MyHH Configuration	<p style="text-align: center;"><b>Informing Service Development</b> (Out of scope)</p>	<p style="text-align: center;"><b>Informing System Diversification</b> (Supplementary focus)</p>

FIGURE 1 – SCOPE OF THIS REVIEW

As highlighted by Leong, Lim [32] in their umbrella review, many of the existing systematic reviews, such as those by Shepperd, Iliffe [22] and Gonçalves-Bradley, Iliffe [21], consist only of experimental research (e.g., randomized controlled trials). Two exceptions are the reviews by Sriskandarajah, Hobbs [29] and Varney, Weiland [31] which also included observational studies.

### *DEFINING AND ALIGNING THE RESEARCH QUESTION*

The aim of this review was to identify and describe recent international evidence-base on who are targeted by home-based admitted care models. The purpose of this was to highlight potential populations for whom the existing My Home Hospital services in South Australia could be extended. As such, the research question was articulated as is commonly done for scoping reviews as: ‘what has been implemented for whom, in what situations and why’?

The probing questions used to further guide the review were:

- i. What are the characteristics of participants in home-based admitted care?
- ii. In which setting and context have these services been implemented or maintained?

The answers to the above questions enabled the exploration of the Population, Concept and Context (PCC) behind home-delivered hospital services as an intermediate care strategy [34].

### *DEVELOPING AND ALIGNING THE INCLUSION CRITERIA*

This review considered studies where a service or intervention enables the delivery of hospital-type care within a home setting. Within this, we were also only interested in the ‘admitted’ subset of hospital services – be they acute, elective, sub-acute or non-acute. Services related primarily to non-admitted (e.g., emergency department, only) and outpatient clinic visits were excluded from the review. Concepts such as ‘admitted’ are not internationally consistent, and so relevant search terms and inclusion criteria were included in the search strategy so that relevant literature was captured.

The search terms and inclusion criteria for the review were not driven by the clinical conditions(s) of patients. It was anticipated *a priori* that studies identified through the review might include services for those top-50 diagnosis-related groups (DRGs) observed by Montalto, McElduff [5] and other clinical conditions that are not listed in that study. We also expected to identify relevant patient groups for whom diagnosis is not their primary defining feature, such as ‘those receiving intravenous fluids’, or where the concept of an intervention to implement or improve home-services is instead targeted not at patient populations but at the formal and informal carers involved in care delivery.

There were no geographical, social, cultural or gender-based interests that were relevant to inclusion criteria in this review. Because of the differences in penetration and distribution of information-communication technologies in health service delivery between high-income and middle to low-income countries, this review only included studies from high-income countries as defined by the World Bank [35].

Any identified literature from before 2017 were excluded from this review. Primary research studies (both qualitative and quantitative) including observational studies, and secondary research such as systematic reviews were be considered. All other letters, guidelines, and commentaries will be excluded. Studies were required to be reported in English and peer reviewed.

### *DESCRIBING THE PLANNED APPROACH*

The approach taken in the review was planned *ex ante* and articulated within a study protocol that was circulated amongst the FHMRI research team and Wellbeing SA stakeholders for input.

### *SEARCHING THE EVIDENCE*

Search terms were taken from existing published reviews, and included ‘hospital at home’, ‘hospital in the home’, ‘HiTH’, ‘hospital care at home’, ‘Home Care Services, Hospital-Based’, ‘Home Care Services’. Terms were further calibrated, to capture the relevant studies known *a priori* through our (i) initial limited search,



including Montalto, McElduff [5]; Page, Comino [36]; Kivic and Hines [37]; Hecimovic, Matijasevic [38]; Lim, De Silva [39]; and Lim, Island [40].

Databases used by the authors were the Cumulative Index to Nursing and Allied Health Literature (CINAHL) and MEDLINE. No gray literature searches were undertaken.

## *SELECTING THE EVIDENCE*

Search results were exported in Rayyan reference management software, and duplicates were removed using the software. Titles and abstracts were screened for eligibility against the criteria (AP, TS and JG).

As outlined in *Figure 2*, 237 full-text copies of records identified through the screening process were obtained for further review. Of these 237, 115 were retained but deprioritised and not reviewed – this included studies that explicitly focused on COVID responses; existing MyHH populations or review articles.

A review of 131 full-text records was conducted to confirm alignment with inclusion criteria described in the protocol (AP, TS, CS). From these, 47 were included for data extraction. Reasons for exclusion were: wrong study type, non-admitted level care, no discernible patient group, or wrong intervention.

Examples of non-admitted level care included reablement and rehabilitation following an acute care episode; Outpatient Parenteral Antibiotic Therapy (OPAT) or ‘medical homes’ that exist largely for primary care services. Transitional, discharge planning, and hospital to home interventions were not included, and neither was the literature on birthing. Approaches to Early Supported Discharge were excluded because the scope of the MyHH service is focused on whole patient journeys.

## *EXTRACTING THE EVIDENCE*

From the 47 included studies, data was extracted to answer the research questions. Metadata was also extracted to map the literature and stratify the study results. From each identified study we extracted into the data charting form:

- Metadata related to the study characteristics
- Targeted and actual population(s), and sub-groups
- The concepts of ‘home-based admitted care’ presented

The data charting form was piloted by the review team using a random selection of the citations, with changes made prior to extracting the data from the remaining identified sources. The team of reviewers (AP, TS, CS) then independently charted the data from the remaining citations, with sample validation by AP and TS.

Upon extraction of data for the included studies, thirteen (13, 27%) described commensurate HITH services for the existing target populations of the MyHH outlined in *Table 1*.

## *ANALYSIS OF THE EVIDENCE*

The literature was charted according to existing classification definitions, themes, and conceptual models of Hospital in The Home services. Individual studies were grouped according to their study design, country of origin, and target populations.

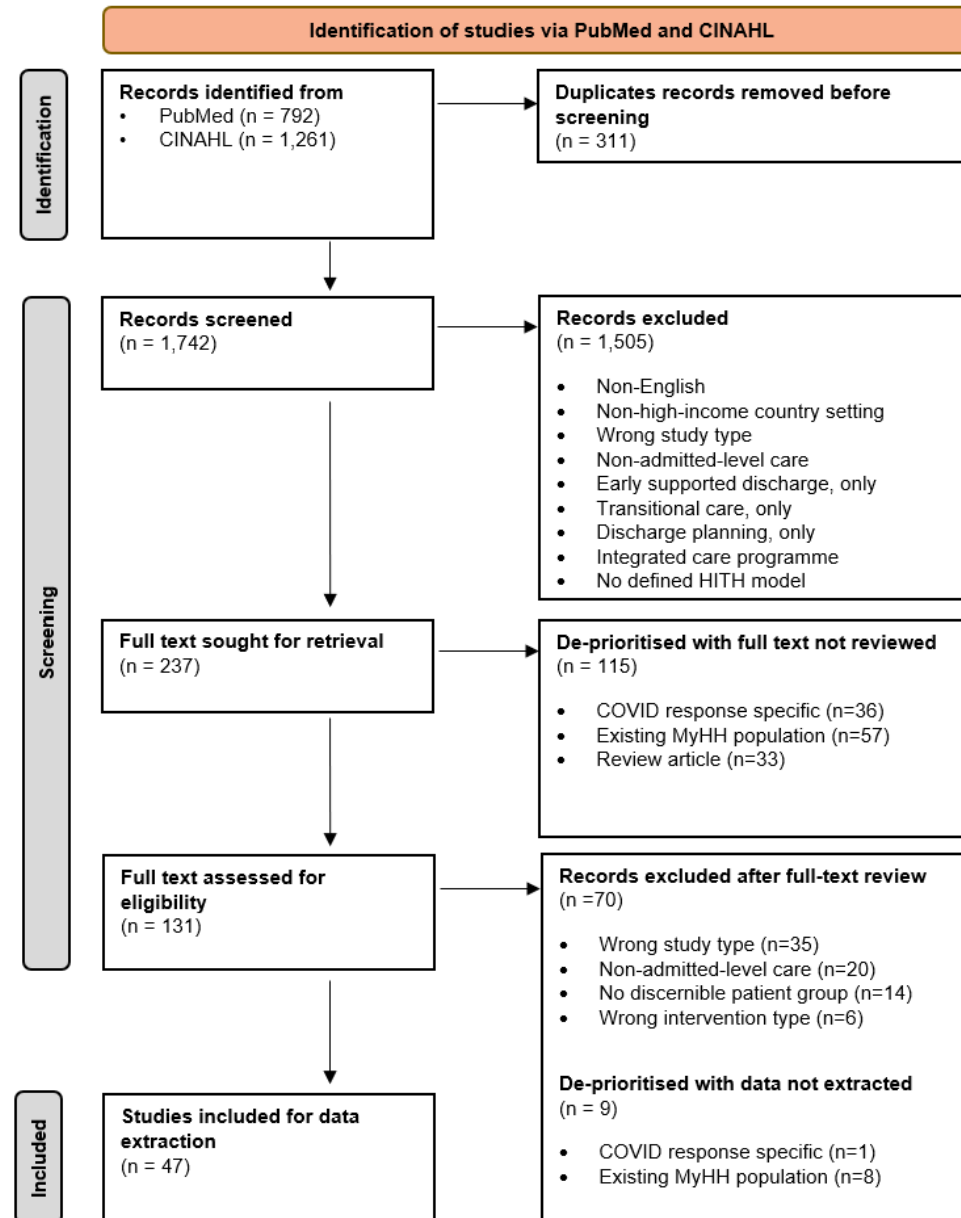


FIGURE 2 – PRISMA FLOW DIAGRAM

## PRESENTATION OF THE RESULTS

Twelve (12, 25%) of the forty-seven (47) included studies were qualitative in design, using a range of interview and document analysis methods. Twenty-seven (27, 56%) were observational studies, including retrospective case note analyses and point-prevalence studies. Nine (9, 19%) were trials or case studies, of which two (2, 4%) were controlled and a further two (2, 4%) included randomisation between intervention and control arms. Seven (7, 15%), were implemented and researched within Australia. Eleven (11, 23%) of the total comprised an economics component.

### *INTERNATIONAL OBSERVATIONAL STUDIES OF HITH ACTIVITY*

There are a several recent observational studies of HITH activity from the international literature, which provide insight into the range of services provided across different settings.

When investigating the status of HITH specifically for older people within the Scottish NHS, Tsiachristas, Ellis [15] found that those in receipt of home-based care were more likely to have multiple long-term conditions.

As represented in *Table 2*, those diagnosis areas with the highest penetration of HITH as a proportion of total activity within the Scottish NHS is that of Parkinson's (24.5% of total activity), and dementia (23.8% of total activity). The areas of greatest HITH activity volumes are 'diseases of the digestive system'; congestive heart disease or 'CHD'; and 'endocrine metabolic disease'. Overall, 16.1% of total hospital-level care within this population is provided though HITH.

TABLE 2 – SCOTTISH NHS PATIENT CHARACTERISTICS AT INDEX ADMISSION BY HITH OR USUAL CARE FOR OLDER PEOPLE, AS TAKEN FROM TSIACHRISTAS, ELLIS [15]

Diagnosis	Hospital	HITH	Total	% HITH
<i>Total</i>	<i>18,977</i>	<i>3633</i>	<i>22,610</i>	<i>16.1</i>
Parkinson's	428	139	567	24.5
Dementia	2887	903	3790	23.8
Epilepsy	658	163	821	19.9
CVD	4058	973	5031	19.3
Renal failure	3565	843	4408	19.1
MS	108	25	133	18.8
Arthritis	5492	1224	6716	18.2
Asthma	2044	439	2483	17.7
Endocrine metabolic disease	6884	1427	8311	17.2
CHD	7083	1449	8532	17
COPD	5234	1065	6299	16.9
Diseases of blood	5412	1104	6516	16.9
Congenital problems	487	98	585	16.8
Diabetes	4343	868	5211	16.7
Disease of digestive system	13,196	2541	15,737	16.1
Atrial fibrillation	5712	1082	6794	15.9
Cancer	5590	980	6570	14.9
Heart failure	3269	545	3814	14.3
Liver disease	754	122	876	13.9

Outlined opposite in *Table 3* is a cross-sectional study from the north-east region of Spain, Catalonia [41] also provides an international observation.

There were a range of twelve (12) different diagnostic groups targeted for HITH within Catalonia during 2014 [41]. The most prominent population group for whom HITH is provided are those with respiratory system diseases, with 2,440 episodes representing 33.8% of their total admission avoidance programme.

Circulatory system and osteomyoarticular and connective tissue diseases appear to be two diagnostic groups for whom admission avoidance is most amenable. On the contrary, lesion and intoxications and digestive tract diseases appear to be most often serviced through an initial hospitalisation, but with HITH supported early discharge models.

Unfortunately, the denominator of non-HITH admitted-level activity for the diagnostic groups is not reported in the study. However, this provides insight into the range of diagnostic groups targeted by HITH services in a comparable international jurisdiction.

TABLE 3 – HITH ACTIVITY VOLUMES BY DIAGNOSTIC GROUP FOR CATALONIA (SPAIN) IN 2014, AS TAKEN FROM ARIAS-DE LA TORRE, ZIOGA [41]

<b>Diagnostic Group</b>	<b>Admission Avoidance n (%)</b>	<b>Early Discharge n (%)</b>
<i>Total</i>	<i>(n = 7214)</i>	<i>(n = 2387)</i>
Respiratory system diseases	2440 (33.8)	780 (32.7)
Genitourinary system diseases	976 (13.5)	412 (17.3)
Circulatory system diseases	1030 (14.3)	234 (9.8)
Osteomyoarticular and connective tissue diseases	747 (10.4)	137 (5.7)
Lesions and intoxications	499 (6.9)	250 (10.5)
Digestive tract diseases	470 (6.5)	268 (11.2)
Skin and subcutaneous tissue diseases	363 (5.0)	79 (3.3)
Neoplasms	247 (3.4)	53 (2.2)
Central nervous system and sense organ diseases	131 (1.8)	62 (2.6)
Badly defined symptoms, signs, and conditions	138 (1.9)	46 (1.9)
Endocrine, nutritional and metabolic diseases, and immunity disorders	106 (1.5)	42 (1.8)
Blood and hematopoietic organ diseases	67 (0.9)	24 (1.0)

The observational study on the Mount Sinai health system by Federman, Soones [42], provides insights into the types of HITH activity within the USA. As shown in *Table 4* opposite, their main admitted diagnoses for HITH in that setting are urinary tract infection; community acquired pneumonia; cellulitis; congestive heart failure; and dehydration.

The numbers in this study from two hospital sites from November 2014 to August 2017 are low in comparison but provide an indication of the range of primary admitting diagnoses in this setting.

TABLE 4 – MOUNT SINAI (USA) PATIENT CHARACTERISTICS BY HITH OR USUAL CARE, AS TAKEN FROM FEDERMAN, SOONES [42]

<b>Primary Admitting Diagnosis</b>	<b>HITH Recipients n (%)</b>	<b>Usual Care Controls n (%)</b>
<i>Total</i>	<i>(n = 295)</i>	<i>(n = 212)</i>
Urinary tract infection	67 (23.3)	28 (13.2)
Community acquired pneumonia	56 (19.1)	40 (18.9)
Cellulitis	44 (15.0)	41 (19.3)
Congestive heart failure	34 (11.6)	42 (19.8)
COPD exacerbation	23 (7.9)	18 (8.5)
Asthma exacerbation	15 (5.1)	20 (9.4)
Dehydration	31 (10.6)	4 (1.9)
Deep venous thrombosis	1 (0.3)	8 (3.8)
Diverticulitis	7 (2.4)	0
Hyperglycaemia	3 (1.0)	5 (2.4)
Hypertension	0	1 (0.5)
Other diagnoses	11 (3.8)	1 (2.4)

## AUSTRALIAN OBSERVATIONAL STUDIES OF HITH ACTIVITY

HITH services across the state of Queensland (QLD) have recently been profiled in a 2017 snapshot of public and public-private-partnership provided services [37]. Abstracted in *Table 5*, opposite, are the ten (10) DRGs that are targeted by the programme. These could be rolled-up into seven (7) ADRGs, with different levels of complexity, but are presented in their DRG format.

As indicated by the frequencies of admissions, by far the largest patient group is that of those requiring care for cellulitis, across both minor and major levels of complexity. The least frequent HITH services are for those requiring care for heart failure and shock (F62) and septicaemia (T60). These two ADRGs are also those that are most serviced by the public HITH programme, rather than the public-private partnership.

A national profile, as reported by Montalto, McElduff [5] is provided in *Table 6* which identifies the top-50 ADRGs of HITH activity across Australia, sorted by the proportion of HITH within the total number of episodes over the period of 2011 to 2017.

As evident within the table, is that across the country some service areas have

- High levels of HITH penetration but low total HITH volumes e.g., septic arthritis (ADRG: I67) which has a penetration of 33.4% but 453 admissions, nationally; or
- Low levels of HITH penetration, but very high levels of total HITH volumes e.g., septicaemia (ADRG: T60) which has a penetration of 6.6% but 2,055 admissions, nationally; or
- A combination of high penetration and high volumes e.g., cellulitis (ADRG: J64) which has a penetration of 21.2% and 13,488 admissions, nationally; or
- A combination of low penetration and low volumes e.g., colonoscopy (ADRG: G48) which has a penetration of 2.9% and 526 admissions, nationally

TABLE 5 – PROFILE OF QUEENSLAND TARGET POPULATIONS FOR HITH WITH 2017 ACTIVITY VOLUMES, BASED ON KIVIC AND HINES [37]

DRG Code	DRG Description	Admissions	
		Public HITH	PPP HITH
J64B	Cellulitis, minor complexity*	933	1048
J64A	Cellulitis, major complexity*	491	352
L63A	Kidney and urinary tract infections, major complexity*	169	77
L63B	Kidney and urinary tract infections, minor complexity*	121	98
E62A	Respiratory infections and inflammations, major complexity*	157	71
E62B	Respiratory infections and inflammations, minor complexity*	138	104
F62B	Heart failure and shock, minor complexity*	75	4
G70A	Other digestive system disorders, major complexity	43	37
E65A	Chronic obstructive airways disease, major complexity*	108	8
T60B	Septicaemia, intermediate complexity	75	20

\* Existing MyHH target population; PPP: Public-Private Partnership

TABLE 6 – AUSTRALIAN NATIONAL PROFILE OF HITH RELATED ACTIVITY FOR 2011 TO 2017,  
AS TAKEN FROM MONTALTO, McELDUFF [5]

ADRG Code	ADRG Description	Total	Admissions	
			HIH	HIH proportion (95% CI)
I67	Septic arthritis	1356	453	33.4% (30.9–35.9%)
I64	<i>Osteomyelitis*</i>	4182	1317	31.5% (30.1–32.9%)
F63	<i>Venous thrombosis*</i>	7856	2469	31.4% (30.4–32.5%)
G60	Digestive malignancy	11,174	3361	30.1% (29.2–30.9%)
F61	Infective endocarditis	1653	494	29.9% (27.7–32.1%)
Z63	Other follow-up after surgery or medical care	5543	1429	25.8% (24.6–26.9%)
J64	<i>Cellulitis*</i>	63,575	13,488	21.2% (20.9–21.5%)
E60	<i>Cystic fibrosis*</i>	9111	1714	18.8% (18.0–19.6%)
I73	<i>Aftercare of musculoskeletal implants or prostheses*</i>	4337	774	17.8% (16.7–19.0%)
H61	Malignancy of hepatobiliary system and pancreas	8141	1365	16.8% (16.0–17.6%)
T64	Other infectious and parasitic diseases	6673	1056	15.8% (14.9–16.7%)
E61	<i>Pulmonary embolism*</i>	13,230	2011	15.2% (14.6–15.8%)
I12	Miscellaneous musculoskeletal procedures for infection or inflammation of bone and joint	11,667	1706	14.6% (14.0–15.3%)
B68	Multiple sclerosis and cerebellar ataxia	4977	679	13.6% (12.7–14.6%)
T01	Infectious and parasitic diseases with major general interventions	10,732	1192	11.1% (10.5–11.7%)
E63	Sleep apnoea	22,534	2467	10.9% (10.5–11.4%)
J06	Major procedures for breast disorders	12,810	1368	10.7% (10.1–11.2%)
T61	Postoperative and post-traumatic infections	11,215	1101	9.8% (9.3–10.4%)
J60	Skin ulcers	4126	404	9.8% (8.9–10.7%)
I72	Specific musculotendinous disorders	6870	646	9.4% (8.7–10.1%)
R02	Other neoplastic disorders with major general interventions	3858	355	9.2% (8.3–10.1%)
B72	Nervous system infection except viral meningitis	3919	360	9.2% (8.3–10.1%)
F06	Coronary bypass without invasive cardiac investigation	19,031	1601	8.4% (8.0–8.8%)
K01	General interventions for diabetic complications	6215	521	8.4% (7.7–9.1%)

J12	Lower limb procedures with ulcer or cellulitis	2668	220	8.2% (7.2–9.3%)
F04	Cardiac valve procedures with cardiopulmonary bypass pump without invasive cardiac investigation	15,927	1311	8.2% (7.8–8.7%)
J63	<i>Non-malignant breast disorders*</i>	2185	160	7.3% (6.2–8.4%)
I04	Knee replacement	22,057	1599	7.2% (6.9–7.6%)
R60	Acute leukaemia	10,755	736	6.8% (6.4–7.3%)
L67	Other kidney and urinary tract disorders	19,329	1295	6.7% (6.3–7.1%)
T60	Septicaemia	31,253	2055	6.6% (6.3–6.9%)
J67	Minor skin disorders	7461	395	5.3% (4.8–5.8%)
G11	Anal and stomal procedures	11,986	631	5.3% (4.9–5.7%)
I03	Hip replacement	25,986	1367	5.3% (5.0–5.5%)
Z64	Other factors influencing health status	15,715	775	4.9% (4.6–5.3%)
E71	Respiratory neoplasms	12,613	593	4.7% (4.3–5.1%)
J08	Other skin grafts and debridement procedures	13,094	582	4.4% (4.1–4.8%)
Q62	Coagulation disorders	5114	225	4.4% (3.8–5.0%)
D66	Other ear nose mouth and throat disorders	11,128	484	4.3% (4.0–4.7%)
J11	Other skin subcutaneous tissue and breast procedures	6379	272	4.3% (3.8–4.8%)
L63	<i>Kidney and urinary tract infections*</i>	53,124	2135	4.0% (3.9–4.2%)
F75	Other circulatory disorders	24,992	1002	4.0% (3.8–4.3%)
X63	Sequelae of treatment	21,045	782	3.7% (3.5–4.0%)
E42	Bronchoscopy	9521	337	3.5% (3.2–3.9%)
E65	<i>Chronic obstructive airways disease*</i>	53,478	1857	3.5% (3.3–3.6%)
P66	Neonate admission weight 2000–2499 g w/o significant general intervention or ventilation for >95 h	12,814	438	3.4% (3.1–3.7%)
E62	<i>Respiratory infections and inflammations*</i>	76,476	2478	3.2% (3.1–3.4%)
X06	Other procedures for other injuries	19,043	574	3.0% (2.8–3.3%)
G48	Colonoscopy	18,006	526	2.9% (2.7–3.2%)
K60	Diabetes	23,615	651	2.8% (2.5–3.0%)

\* Existing MyHH target population



## *TRIALLED MODELS AND POPULATION-SPECIFIC CASE STUDIES*

There were found to be five (5) novel target populations based on broad diagnosis or health needs characteristics, including: dehydration and electrolyte imbalances; falls, frailty and functional decline; delirium; asthma exacerbation; and diabetic foot ulcer. These five groups are abstracted, below, and a full list of the included studies provided in *Appendix 1 – Included Studies*.

There were other services identified through the review, but which were less prevalent. These included services for those with needs associated with diverticulitis [43], colostomy [44], parenteral nutrition [44], obstructive sleep apnoea [45], stem-cell transplantation [46], multiple sclerosis [47], Diabetic foot ulcer [48, 49], and “a cancer” [50].

### ***Dehydration and electrolyte imbalances***

Dehydration, electrolyte imbalances and volume depletion were one of the main admitted diagnoses within the studies Saenger, Ornstein [51] and Mann, Zepeda [52], who reported on the cost savings of HITH programmes and adverse drug events, respectively. It also featured as a common diagnosis group in the study by Tierney, Melby [53], and the case study reported by Ross, Dritz [54].

Saenger, Federman [55], outlined that those admitted for dehydration were more inclined than many other patient groups to accept HITH services over traditional hospital treatment. Rayner and Fetherstonhaugh [56] noted in their study on residential care facility in-reach within Australia, that when patients are totally dehydrated, that the necessary IV treatment is something aged care providers attempt push onto the hospital sector.

### ***Falls, frailty, and functional decline***

Within Australia, detailed patient phenotyping for HITH programmes within aged populations at risk of falls, frailty and functional decline have been conducted by Loveland, Reijnierse [57].

HITH for falls, frailty and functional decline has also been the subject of a large multicentre RCT in the UK by Shepperd, Craddock-Bamford [13], included

comprehensive geriatric assessments as an approach to maintaining people in their own home. Cai, Grubbs [48] similarly focused on the use of HITH in an older and frail USA population, to help keep them in their own home and at lower costs to hospital and aged care systems.

High rates of satisfaction have been captured in surveys by Facultad and Lee [58] of a frail and vulnerable population of HITH users, and qualitative studies have specifically highlighted the roles of personal, relational and environmental factors within a patient’s home, as critical resources to help manage HITH implementation and transitions to/from/around hospitalisations [16].

HITH in this population is not only for chronic disease management or elective admissions but may also be suitable for acute medical crises [59].

### ***Delirium***

Delirium as a consideration within home-based care is not new, but a new Australian perspective has been provided by Chia, Eeles [60], where they reported on the safety and efficacy of a specific hospital-in-the-home delirium pathway (THDP) in Queensland. Their findings indicate that HITH may provide an alternative to in-hospital care in this population group.

Delirium also featured within a large number of the older HITH admitted patients within the Shepperd, Craddock-Bamford [13] multicentre RCT in the UK. Loveland, Reijnierse [57] also noted that new or worsening delirium is itself a negative health event associated with hospitalisation.

### ***Asthma exacerbation***

Separate or in addition to COPD, an acute exacerbation of Asthma is another potential target population present within the trial literature. It is presented as a possible delineation to the existing COPD target population for hospital-level care in the home in the studies by Levine, Ouchi [61], Levine, Pian [62] and Levine, Paz [63].

## SUMMARISING THE EVIDENCE - INSIGHTS FOR MYHH IN SOUTH AUSTRALIA

### TRIANGULATION OF EVIDENCE

The Australian observational study of data from 2011 to 2017 by Montalto, McElduff [5] provides the best snapshot of relevant HITH activity, and the targeted populations across the country.

A number of those presented within *Table 6* are existing MyHH Service populations, including services for: osteomyelitis (ADRG: I64); venous thrombosis (ADRG: F63); cellulitis (ADRG: J64); cystic fibrosis (ADRG: E60); aftercare of musculoskeletal implants or prostheses (ADRG: I73); pulmonary embolism (ADRG: E61); non-malignant breast disorders (ADRG: J63); kidney and urinary tract infections (ADRG: L63); chronic obstructive airways disease (ADRG: E65); and respiratory infections and inflammations (ADRG: E62). These existing target population are highlighted within the table and outlined in *Figure 3*, opposite.

The QLD HITH experience reported by Kivic and Hines [37] outlines that eight out of ten of their target populations, directly overlap with the existing MyHH Service populations in SA. The two unique HITH services run in QLD but not in SA include: Other digestive system disorders, major complexity (ADRG: G70A); and septicaemia, intermediate complexity (ADRG: T60B).

Chest pain (ADRG: F74) and Lymphoma and non-acute leukaemia (ADRG: R61) were target populations within Tranche 2 of the MyHH implementation. Neither of these are currently observed as a Top 50 cohort to have been treated through HITH services in Australia, nor are they focus of services in other states of Australia. HITH activity for heart failure and shock (ADRG: F62) is similarly not observed within the Top 50 of Australian activity but is a focus of QLD Health services [37], and a HITH model in the Victoria [64].

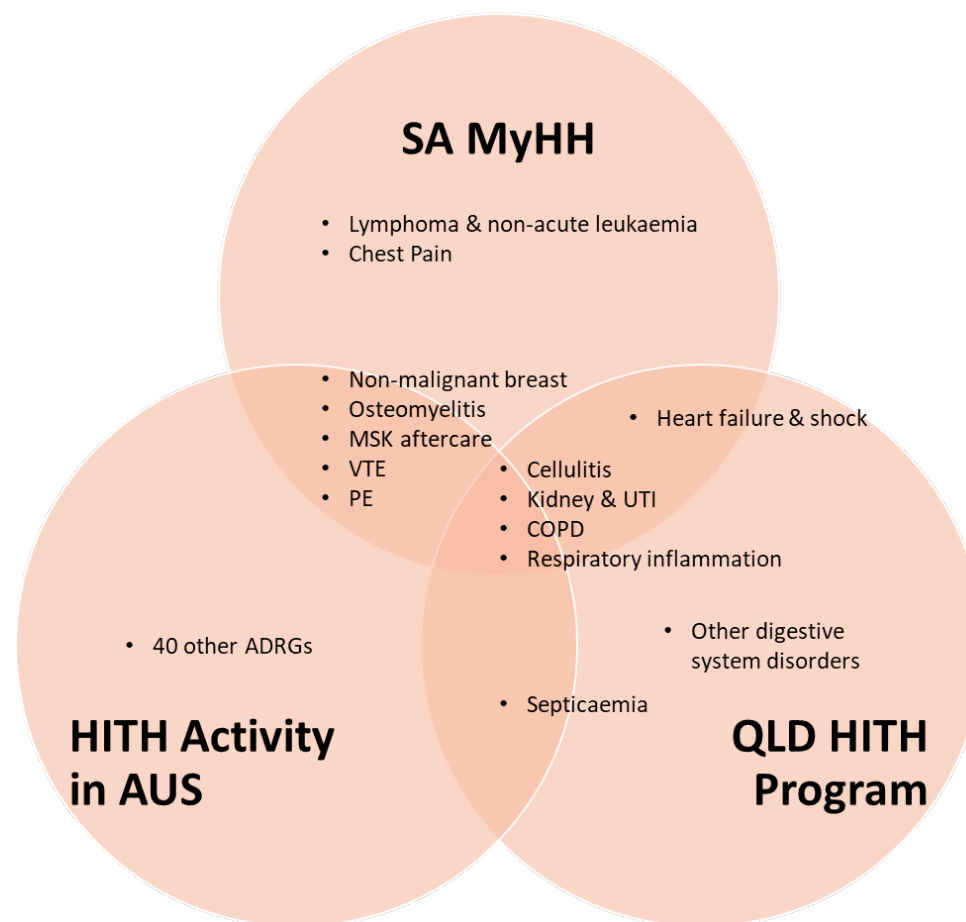


FIGURE 3 - TRIANGULATING OBSERVATIONAL STUDY EVIDENCE

MSK: musculoskeletal; VTE: venous thromboembolism; PE: pulmonary embolism; UTI: urinary tract infection; COPD: Chronic Obstructive Pulmonary Disorder.

When looking at the clinical trial and population-specific case study literature, there are several prominent service areas that are not observed within the Australian activity profile from 2011 to 2017 (*Table 6*). These include services related to dehydration and electrolyte imbalances; falls, frailty, functional decline; delirium; and asthma exacerbation.

The types of services for diabetic foot ulcer studied by Cai, Grubbs [48] and Cai, Laurel [49] are observed within the Australian activity profile (*Table 6*). These services, however, appear to have historically attracted low-volumes of episodes, or the HITH components have only comprised a low-proportion of total activity.

- K01 – General interventions for diabetic complications was observed to be coded against 6,215 episodes of care between 2011 and 2017, nationally. Of these 8.4% (n=521) were provided through HITH.
- K60 – Diabetes was observed to be coded against 23,615 episodes between 2011 and 2017, nationally. Of these 2.8% (n=651) were provided through HITH.
- K09 – Other Endocrine, Nutritional and Metabolic GIs episodes were not observed within the national activity profile from 2011 to 2017.

Wound care does not necessarily need to be associated with subcutaneous infection. There may be other types of wound care that are suitable for home settings.

## ***OPTIONS FOR SERVICE EXTENSION***

The first type of potential service extension options arises from the HITH activity observed across Australia. The second relate to those service areas that emerge from the international literature on novel models that have undergone clinical trials or are the focus of case study applications. The full range of potential additional target populations for the MyHH-type service in SA are summarised in *Table 7*, below.

### ***From activity observed across Australia***

Based on the HITH activity observed across Australia, three (3) approaches to extending the existing MyHH services are proposed. This includes an approach

that looks at those ADRG services with (i) a high proportion of total activity delivered through HITH; (ii) a high volume of episodes delivered through HITH; and (iii) areas in which other commensurate programmes have targeted specific ADRGs and may provide directly relevant lessons.

#### ***(i) High Proportion Services***

In looking at the Australian HITH activity profile within *Table 6* from Montalto, McElduff [5], and taking into consideration the overlap with existing SA MyHH services, those ADRGs that are indicated to be provided through a high proportion of HITH may be relevant targets for extending the service in SA. These include:

- I67 – Septic arthritis, of which 33.4% is delivered through HITH
- G60 – Digestive malignancy, of which 30.1% is delivered through HITH
- F61 – Infective endocarditis, of which 29.9% is delivered through HITH

New evidence on novel approaches will continue to emerge and warrants further iterative review and horizon scanning. For example, we identified some emerging evidence by Rajapakse, Wee [65] for infective endocarditis; however, this particular study was excluded from the review because it was only a conference abstract (i.e., wrong study type). Septic arthritis is something that also seen in the observational study from Spain [41].

#### ***(ii) High Volume Services***

Regardless of the proportion of total activity delivered through HITH, there are a number of ADRGs for which there are a high volume of HITH episodes of care. After accounting for those already provided through the MyHH in SA, there are four (4) populations that stand-out as potential targets.

- G60 – Digestive malignancy, which was coded against 3,361 HITH episodes across Australia during the period of 2011 to 2017. As noted above, this is also a service area of high HITH penetration.
- I12 – Miscellaneous musculoskeletal procedures for infection or inflammation of bone and joint, which was coded against 1,706 HITH episodes across Australia during the period of 2011 to 2017.

- E63 – Sleep apnoea, which was coded against 2,467 HITH episodes across Australia during the period of 2011 to 2017.
- T60 – Septicaemia, which was coded against 2,055 HITH episodes across Australia during the period of 2011 to 2017.

Miscellaneous musculoskeletal procedures for infection or inflammation of bone and joint (I12) likely aligns well with the existing osteomyelitis care (ADRG: I64) already provide through the MyHH in SA. This service extension may help boost the total HITH activity volumes around these patients and carers, which are otherwise generally high proportion but low volume services.

Sleep apnoea (E63) is an interesting observation, and the suggestion here that it is a suitable high-volume approach target is tempered by the question raised by Montalto, McElduff [5] as to whether it is truly admitted-level care, or simply a miscoding of outpatient (i.e., non-admitted) activity. This would require further investigation.

### *(iii) Other target services*

There are a couple of other potential target services which are worthwhile flagging because they feature within the QLD HITH programme [37], but which are not existing MyHH services in SA.

- G70 – Other digestive system disorders.
- T60 – Septicaemia, which is also observed as a high-volume service.

In addition to its featuring in the QLD HITH model, services for Other digestive system disorders (ADRG: G70) is associated with the inpatient diagnosis codes for diverticulitis (ICD: K57 Diverticular disease of intestine), studied by Hamilton, Crosthwaite [43]. The authors reported there being no complications and concluded that the service is a potentially safe alternative to hospital-based care.

### ***From trialled models and population-specific case studies***

Based on the results of the literature review into the international HITH literature, there are four disease or population groups who have been identified as potential additional target for the MyHH service in SA. These include services for (i)

dehydration and electrolyte imbalances; (ii) falls, frailty and functional decline; (iii) delirium; and (iv) asthma exacerbation.

### *(i) Dehydration and electrolyte imbalances*

A scan of Australian activity data indicates that the inpatient diagnosis codes for dehydration and electrolyte imbalances (E86 Volume Depletion) are associated with ADRG categories:

- K62 – Miscellaneous Metabolic Disorders
- K40 – Endoscopic and Investigative Interventions for Metabolic Disorders

In addition to trialled models and case studies that looked at dehydration, the observations of HITH activity by Federman, Soones [42], also highlighted dehydration as an area of practice within the USA.

### *(ii) Falls, frailty, and functional decline*

A scan of Australian activity data indicates that related emergency department diagnoses for falls, frailty and functional decline in those aged 65 years and older presenting to a hospital and receiving an Australasian Triage Scale score of 3 to 5, may include the below:

- R55 Syncope and collapse
- W19 Unspecified fall
- S72 Fracture of femur
- R53 Malaise and fatigue
- R42 Dizziness and giddiness
- W01 Fall same level from slip trip and stumble

The admitted-level care associated with those ED presentations is coded across several ADRG categories, including:

- F73 – Syncope and collapse
- X60 – Injuries
- J65 – Trauma to skin, subcutaneous Tissue and Breast
- D61 – Disequilibrium

- B80 – Other head injuries
- X64 – Other injuries, poisonings, and toxic effects

It is worth noting that there is potentially some overlap between functional decline and delirium (ADRGs: B63 and B64).

#### *(iii) Delirium*

A scan of Australian activity data indicates that the inpatient diagnosis codes for delirium (F05 Delirium) are associated with ADRG categories:

- B64 – Delirium
- B63 – Dementia & Other Chronic Disturbances of Cerebral Function

#### *(iv) Asthma exacerbation*

A scan of Australian activity data indicates that the inpatient diagnosis codes for diverticulitis (J45.0 Predominantly allergic asthma; J45.9 Asthma, unspecified; and J46 Status asthmaticus) are predominantly associated with ADRG categories:

- E69 – Bronchitis and Asthma

### **OPTIONS FOR SYSTEM DIVERSIFICATION**

Observed within the literature were services for population groups who are not within the current scope of eligible patients for the existing MyHH configuration, but who might benefit from a similar home-based care service. This includes early supported discharge following surgery; services for children (<18 years old); palliative end-of-life care; mental health services; and rural health services.

Abstracted below is the identified evidence for four population groups, as potential areas into which new configurations of HITH services in SA might be diversified.

#### *Post-Surgery Early Supported Discharge*

The first option for system diversification is that of Early Supported Discharge (ESD), particularly following surgical procedures. The literature on this topic was

excluded from the review, as it was beyond the scope of the current MyHH services. However, there are many existing and future HITH services that are focused on ESD models. Looking specifically at the Australian activity profile, we can see that there are three services where there is either a high proportion of total activity provided through HITH, or a high volume of HITH episodes. These include:

- Z63 – Other follow-up after surgery or medical care, of which 25.8% is delivered through HITH
- F06 – CABG without invasive investigation, which was coded against 1,601 HITH episodes across Australia during the period of 2011 to 2017
- I04 – Knee replacement, which was coded against 1,599 HITH episodes across Australia during the period of 2011 to 2017

#### *Children's Services*

Emerging from the literature review were a number of HITH models related to Children's services. Children are currently ineligible to receive MyHH services in SA, however, many indications for which home-based care are warranted within adults, are similarly relevant to children Cabrera López, Agúndez Reigosa [66].

While different types of professional competencies are required when caring for children, HITH for children has been found to help support family life [67, 68]. Published experiences suggest it can be safe and feasible [69]; however, additional efforts might be required to ensure continuity of care and adherence to treatment regimens for children in home-settings [70]. It is also less likely that HITH could substitute the whole of a hospital stay, and so a hybrid of ESD programme may be required Townson, Lowes [71].

#### *Palliative care as 'hospice at home'*

Palliative care and hospice services in the home is a heavily researched service area. Health systems have demonstrated financial benefits [72, 73], some of which is derived from the avoidance of re-hospitalisations [74]. It has been shown home-based palliative care can assist with providing longer survival and more time at home in the final stages of life [75], Wang, Liu [76], [77]. The need for

specialised palliative care will likely grow [78]; however, integration with hospital and local care supports is integral to minimising unwarranted variations [79].

A point raised in the literature, is that broad social and spiritual supports for family caregivers is required to increase their resiliency, and so that costs aren't shifted to the informal sector [80, 81].

While it is admitted-level care that may be relevant to the MyHH in SA, we note that it is typically funded through Tier 2 sub/non-acute Activity Based Funding classification, rather than acute DRGs.

#### *Mental health, both disorders of mood and thought*

Home crisis intervention teams have also been raised as an alternative to hospitalisation [82], with evidence suggesting that there are comparable clinical and social outcomes [83].

Like palliative care funding – While it is traditionally admitted-level care, mental health services are not necessarily funded and demarcated as DRG activity.

#### *Rural*

Evidence from the USA suggests there are positive patient attitudes towards implementing HITH services in rural settings, that are similar to those that are becoming common in urban settings [84]. The potential barriers uncovered by Levine, Desai [84] include internet connectivity and rural hospital politics, but they suggest that urban models can be suitably adapted to navigate these issues.

TABLE 7 – ADRGs OF POTENTIAL ADDITIONAL TARGET POPULATIONS FOR MYHH-TYPE SERVICES

Service Extension		System Diversification
Activity observed within AUS	Trialled models and population-specific studies	
<b>High Proportion Services</b>	<b>Dehydration and electrolyte imbalances</b>	Post-Surgery Early Supported Discharge
I67 – Septic arthritis	K62 – Miscellaneous metabolic disorders	Children’s services
G60 – Digestive malignancy	K40 – Endoscopic and investigative interventions for metabolic disorders	Palliative care
F61 – Infective endocarditis	<b>Falls, frailty, and functional decline</b>	Mental health
<b>High Volume Services</b>	F73 – Syncope and collapse	Rural and remote services
G60 – Digestive malignancy	X64 – Other injuries, poisonings, and toxic effects	
I12 – Miscellaneous musculoskeletal procedures for infection or inflammation of bone and joint	X60 – Injuries	
E63 – Sleep apnoea	J65 – Trauma to skin, subcutaneous tissue and breast	
T60 – Septicaemia	D61 – Disequilibrium	
	B80 – Other head injuries	
<b>Other Targets Services</b>	<b>Delirium</b>	
G70 – Other digestive system disorders	B64 – Delirium	
T60 – Septicaemia	B63 – Dementia & other chronic disturbances of cerebral function	
	<b>Asthma exacerbation</b>	
	E69 – Bronchitis and asthma	

## CONCLUDING COMMENTS

When looking at existing inpatients within a major hospital in Melbourne, Australia, Lim, Island [40] came to the conclusion that *"one-tenth of hospitalised inpatients are potentially suitable for home-based inpatient bed substitutive care"*. If considering it from a 'home first' perspective, the major barriers to moving patients to a home-setting to receive care include where they are not functionally or cognitively suitable; awaiting investigation/procedure (presumably, that can only be conducted in hospital); and/or are clinically unstable [40].

Wide-ranging observational studies, such as that by Montalto, McElduff [5], provide insights into the average proportions of HITH within total admissions for particular DRG classes. This can give us a general benchmark for how specific services may be provided.

Of those receiving care within Sydney Local Health District (SLHD) who are of similar populations to the MyHH service in SA, namely those with needs for cellulitis (J64B); kidney (L63B); and respiratory infection (E62) services, 26% participated in HITH [36].

It was also observed that age, comorbidities, and other factors such as sex, language spoken at home and socio-economic status were significantly associated with participation in the SLHD HITH programme. The authors suggested that with HITH programmes *"... targeted efforts are required to ensure under-represented populations can enjoy the health services they need"* [36]. It is not a single-jurisdiction or single-HITH programme problem. As has also been observed within Melbourne - older people; those with greater comorbidities; and those referred from inpatient from than ED settings, possess increased risks of having poorer HITH outcomes and incurring down-stream costs [39]. To address these common shortcomings, genuine consultation of service design, followed by ongoing communication between carers, both formal and informal, and the patient is crucial [85].

Home-based care removes patients from a physical environment that poses risks of infection, falls and other complications. It is thought to be because of change in

setting, that services in the South West Sydney LHD (SWSLHD) have been seen to have low rates (2-3%) of subsequent ED presentations for HITH patients [38].

However, the SWSLHD services are predominantly for administration of intravenous medications. Indeed, most of the HITH services across the whole of countries such as the UK are still focused on non-admitted level care [86]. There are a range of existing services, such as those for VTE and PE, that in the near future, will no longer be expected to require a hospitalisation or admitted-level care.

For anyone who reviews the literature, there are many instances of service models which are not defined by the patient populations, their symptoms, health needs or characteristics. Instead, it is not uncommon that the services and patient populations are characterised by the technological components of care e.g., "those receiving intravenous fluids". This non-patient-centred approach masks the relevant characteristics and preferences of people who require care.

ADRGs provide some additional insight into the type of patient needs. However, these are coded *ex post*, following the separation of an episode of care, and not readily identifiable up-front at the point when decisions are being made about patient referrals and their onward trajectory through or away from a HITH service. In the future, rather than using ADRGs or other classifications used for funding purposes, clinical and even socio-cultural factors might be better defined as the criteria for MyHH inclusion.

The insights provided here are based on observed HITH activity across Australia and the development of novel service delivery models, published within the international literature. To prioritise between these options, further local evidence can be used to profile the expected costs and effects of different options, relative to each other.



## APPENDIX 1 – INCLUDED STUDIES

TABLE 8 – TABLE OF INCLUDED STUDIES

Authors	Title	Year of Publication	Country of Origin	Study Design	Novel Target Populations	Excerpts from Conclusions
Montalto, Michael. McElduff, Patrick. Hardy, Kristy. [5]	Home ward bound: features of hospital in the home use by major Australian hospitals, 2011-2017	2020	Australia	Observational	Multiple - see table	HIH care is most frequently provided to patients requiring hospital treatment related to infections, venous thromboembolism, or post-surgical care. Its use could be expanded in clinical areas where it is currently used and extended to others where it is not. HIH activity is growing. It should be systematically monitored and reported to allow better overview of its use and outcomes.
Kivic, Amanda. Hines, Lauren. [37]	Using governance and patient flow strategies to improve healthcare service efficiency	2021	Australia, (QLD)	Observational	Other digestive system disorders (G70); Septicaemia (T60)	The subjects for this study were Queensland's HITH services as they operated in 2017. However, the authors propose that the use of governance strategies, CLD and financial incentives may be applied to a broad range of healthcare services, including inpatient, out-patient and community-based services. The authors do not suggest that the use of PPP models of care will necessarily reduce ALOS. In this case, it was the conditions written into the PPP contracts plus individual hospital initiatives that are likely to have facilitated desirable KPI outcomes. The authors conclude that should the strategies noted above be applied to other healthcare services, they are likely to support safe, shorter ALOS compared with services that are not using these measures.
Chia, J. Eeles, E. M. Tattam, K. Yerkovich, S. [60]	Outcomes for patients with delirium receiving hospital-in-the-home treatment: An Australian perspective	2020	Australia, (QLD)	Observational	Delirium	The hospital-in-the-home delirium pathway is a promising alternative to in-hospital delirium care for selected patients.
Loveland, Paula M. Reijnierse, Esmee M. Island, Louis. et al., [57]	Geriatric home-based rehabilitation in Australia: Preliminary data from an inpatient bed-substitution model	2022	Australia, (VIC)	Retrospective cohort study	Falls; functional decline; delirium	Hospitalization-associated decline in mobility and functional independence improved at discharge and three-months, but was not fully reversed in the multidisciplinary home-based geriatric rehabilitation bed substitution service. Future research should compare outcomes to equivalent hospital-based geriatric rehabilitation and evaluate patient perspectives.

Rayner, J. A. Fetherstonhaugh, D. [56]	What factors influence nursing home use of hospital avoidance programs? An interview study	2022	Australia, (VIC)	Qualitative	IV fluids	The residential-in-reach services are highly regarded by nursing homes. However, some are reliant on these services to provide nursing assessment and management. Using residential-in-reach services to substitute for nursing care, deskills nurses and shifts the cost of providing care from the service provider to other agencies. To provide residents with quality nursing care, the number of skilled registered nurses able to work within their scope of practice needs to be increased in Australian nursing homes.
Hamilton, J. Crosthwaite, G. Montalto, M. [43]	Hospital in the home-based management of acute diverticulitis: a safe and effective alternative to inpatient care	2021	Australia, (VIC)	Retrospective casenote review	Diverticulitis	In this study, the lack of complications demonstrated indicates that HIH-based management of acute diverticulitis may be a viable and safe alternative to inpatient care.
Lippert, M. Semmens, S. Tacey, L. et al., [69]	The Hospital at Home program: no place like home	2017	Canada	Observational	Children with cancer	Family surveys suggested less disruption in daily routines and appreciation of specialized care by hematology and oncology nurses. Staff surveys highlighted a perceived benefit of H@H in contributing to early discharge of patients by supporting out-of-hospital monitoring and teaching. <b>Conclusions</b> The development of a H@H program dedicated to the paediatric hematology, oncology, or bmt patient appears feasible. Our pilot program offers a potential contribution to improvement in patient quality of life and in cost–benefit for parents and the health care system.
Singh, S. Gray, A. Shepperd, S. et al., [14]	Is comprehensive geriatric assessment hospital at home a cost-effective alternative to hospital admission for older people?	2022	England	Observational / modelled	Frailty	CGA HAH is a cost-effective alternative to admission to hospital for selected older people.
Devani, N. Pramono, R. X. A. Imtiaz, S. A. et al., [45]	Accuracy and usability of AcuPebble SA100 for automated diagnosis of obstructive sleep apnoea in the home environment setting: an evaluation study	2021	England	Non-controlled trial / case study	Obstructive sleep apnoea	These results validate the efficacy of AcuPebble_SA100 as an automated diagnosis alternative to cardiorespiratory polygraphy; also demonstrating that AcuPebble_SA100 can be used by patients without requiring human training/assistance. This opens the doors for more efficient patient pathways for OSA diagnosis.
Rees-Roberts, M. Williams, P. Hashem, F. et al., [79]	Hospice at Home services in England: a national survey	2021	England	Observational	Palliative (adults)	There is considerable variation in HAH services in England. Services work to supplement local care using a flexible approach benefitting from integration and funding. Further work defining service features related to patient and/or carer outcomes would support future service development.

Vaartio-Rajalin, H. Fagerstrom, L. Santamaki-Fischer, R. [44]	"They Know Me and My Situation-- Patients' and Spouses' Perceptions of Person-Centered Care in Hospital-at-Home Care"	2021	Finland	Qualitative	Erysipelas eczema; Colostomy; parenteral nutrition	The home environment enabled principles and activities related to person-centered care, for both patients and spouses. Certain structures and processes are necessary for the implementation of person-centered hospital at home (HAH) care: sharing personal knowledge, recognizing its value, and collaborating in a personalized and dignified manner. Both patients and spouses perceived that collaborative (patient, spouse, and staff) situation analysis prior to and during HAH care is very important, for without it there is no person-centeredness.
Rossinot, H. Marquestaut, O. de Stampa, M. [50]	The experience of patients and family caregivers during hospital-at-home in France	2019	France	Qualitative	Cancer	HAH strongly involved the patient's caregiver(s) all along the process. HAH's development necessitates to associate both patients and caregivers and to take into account their needs at every step. This study highlights the need to better assess the ability of the caregiver to cope with his or her relative in HAH with acute and subacute care at home.
Tierney, B. Melby, V. Todd, S. [53]	Service evaluation comparing Acute Care at Home for older people service and conventional service within an acute hospital care of elderly ward	2021	Ireland	Non-controlled trial / case study	Electrolyte disturbance/volume depletion	The Acute Care at Home service is a viable alternative to hospital for older patients. It prevents functional decline and the need for domiciliary care or nursing home placement. It is likely that the Acute Care at Home service has higher mortality and readmissions rates due to treating a higher proportion of dependent, frail older adults.
Cartoni, C. Breccia, M. Giesinger, J. M. et al., [73]	Early Palliative Home Care versus Hospital Care for Patients with Hematologic Malignancies: A Cost-Effectiveness Study	2021	Italy	Non-controlled trial / case study	Palliative (adults)	Compared with hospital, domiciliary assistance produced a weekly saving of e 2314.9 for the health provider, with a charge of e 85.9 for the family, and was cost-effective by an ICER of e -7013.9 of prevented days of care for avoided infections. Conclusions: Current findings suggest that costs of early palliative home care for patients with hematologic malignancies are lower than standard hospital care costs. Domiciliary assistance may also be cost-effective by reducing the number of days to treat infections.
Hamamoto, Y. Ibe, T. Kodama, H. et al., [75]	Retrospective Prognostic Study of Death at Home or Hospice Versus at a Hospital Among Patients With Advanced Non-Small Cell Lung Cancer	2020	Japan	Observational	Palliative care	Patients who died at a hospice or at home exhibited significantly longer survival than those who died at a hospital for advanced non-small cell lung cancer.
Joren, C. Y. de Veer, A. J. E. de Groot, K. Francke, A. L. [81]	Home care nurses more positive about the palliative care that is provided and their own competence than	2021	Netherlands	Observational	Palliative (adults)	Overall, 70% of the nurses rated the quality of palliative care as very good to excellent. This percentage was higher among home care nurses (76.4%) than hospital nurses (59.4%). Moreover, a higher percentage of home care nurses (94.4%) stated they felt competent to a great extent to provide palliative care compared to hospital nurses (84.7%).

	hospital nurses: a nationwide survey					
Wergeland, D. Harsten, K. Klarare, A. Steindal, S. A. [46]	Hospital nurses' experiences of assessing health status changes in stem-cell transplanted patients in home care: A qualitative study	2021	Norway	Qualitative	Stem-cell transplanted patients	Effective communication and clinical intuition enhanced the assessment of patients' general health conditions. The lack of physical presence during remote assessments made using clinical intuition in the assessment process difficult. Experience with hematopoietic stem-cell transplantation was seen as important to facilitate accurate remote clinical assessments.
Aasen, L. Ponton, I. G. Johannessen, A. M. [67]	Being in control and striving for normalisation: A Norwegian pilot study on parents' perceptions of hospital-at-home	2019	Norway	Qualitative	Children	The main finding of this study is that parents prefer HAH above traditional hospitalisation. Most parents stated that they wished for everyone to have this opportunity... The findings indicate that hospital-at-home for children is a good solution if the parents are well prepared and feel in control. In addition, certain structural conditions must be in place before this type of health care is established; there must be a certain volume of patients and the distance to the hospital must be clearly limited.
Tsiachristas, Apostolos. Ellis, Graham. Buchanan, Scott. et al., [15]	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	2019	Scotland	Observational	Multiple - see table	We found differences in the populations admitted to hospital-at-home and hospital. The likely higher cost in all three hospital-at-home cohorts, compared with the hospital cohorts during the 6 months following discharge, highlights the importance of characterising populations eligible to receive these types of healthcare services and of assessing subsequent use of health, social and informal care following admission to hospital-at-home or hospital. The lack of data on the severity of the observed acute and chronic conditions as well as on type of hospitalised care received in the control cohorts means that we cannot rule out the risk of residual confounding, and the findings should be interpreted with caution.
Arias-de la Torre, Jorge. Zioga, Evangelia A. Macorigh, Lizza. et al., [41]	Differences in Results and Related Factors Between Hospital-at-Home Modalities in Catalonia: A Cross-Sectional Study	2020	Spain	Observational	Multiple - see table	The results of HaH in Catalonia are similar to those observed in other contexts. The factors related to these results identified might help to improve the effectiveness and efficiency of the different HaH modalities.
Alba Pale, L. Leon Caballero, J. Corcoles Martinez, D. et al., [82]	Psychiatric Home Hospitalization Unit of the Hospital del Mar A crisis resolution and home treatment team in Barcelona	2019	Spain	Observational	Schizophrenia; Bipolar disorder; Depressive disorder	In summary, despite its limitations, this study provides relevant data regarding improvement in patients' symptoms and functionality, with low risk of associated suicide, and proposes home hospitalisation as an effective alternative to conventional hospitalisation in patients with severe decompensated mental illness. However, more studies are required to support these data and, above all, cost-benefit and qualitative studies to study other important factors such as the effects of this type of care on the family burden.

Mas, M. A. Santaeugenia, S. J. Tarazona-Santabalbina, F. J. et al., [59]	Effectiveness of a Hospital-at-Home Integrated Care Program as Alternative Resource for Medical Crises Care in Older Adults With Complex Chronic Conditions	2018	Spain	Observational	Geriatrics	These preliminary results suggest that the geriatrician-led HHU seems effective in resolving acute medical crises in older patients with chronic disease. Patients attended by the HHU obtained better functional outcomes compared to those from the ICGU, although the groups did have some baseline differences.
Svensson, G. Wahlin, I. [78]	Patient perceptions of specialised hospital-based palliative home care: a qualitative study using a phenomenographical approach	2018	Sweden	Qualitative	Palliative care	The need for specialised palliative care will likely grow with an ageing population and this form of care was perceived as functioning well.
Castor, C. Landgren, K. Hansson, H. Kristensson Hallstrom, I. [68]	A possibility for strengthening family life and health: Family members lived experience when a sick child receives home care in Sweden	2018	Sweden	Qualitative	Paediatric	The findings suggest that care in the family's home is a useful complement to hospital care. Home care should be given with close attention to family members' needs and conditions, as positive effects of home care might be jeopardised when expectations and possibilities are not successfully shared.
Stulz, N. Wyder, L. Maeck, L. et al., [83]	Home treatment for acute mental healthcare: randomised controlled trial	2020	Switzerland	Controlled trial	Mental health	Home treatment services can reduce hospital use among severely ill patients in acute crises and seem to result in comparable clinical/social outcomes and patient satisfaction as standard in-patient care.
Chiang, J. K. Kao, Y. H. [77]	Quality of end-of-life care of home-based care with or without palliative services for patients with advanced illnesses	2021	Taiwan	Non-controlled trial / case study	Palliative	Patients receiving home-based care and palliative services had lower scores regarding aggressive of EOL care and a reduced probability of dying in a hospital. Further study is warranted to verify the results with a larger sample size in future investigations.
Shepperd, Sasha. Craddock-Bamford, Andrea. Butler, Christopher. et al., [13]	Hospital at Home admission avoidance with comprehensive geriatric assessment to maintain living at home for people aged 65 years and over: a RCT	2022	United Kingdom	Randomised controlled trial	Frailty	The results from this randomised trial show no apparent difference between the groups in the primary outcome of living at home (i.e. the inverse of mortality or living in new long-term residential care) at 6-month follow-up, although there were differential effects in each component of the outcome. There was little difference in mortality at 6 or 12 months, but the rate of new long-term residential care was significantly lower among those allocated to hospital at home at 6- and 12-month follow-up.... Comprehensive geriatric assessment hospital at home can provide a cost-effective alternative to hospitalisation for selected older people. Further

						research that includes a stronger element of carer support might generate evidence to improve health outcomes.
Mäkelä, P. Stott, D. Godfrey, M. et al., [16]	The work of older people and their informal caregivers in managing an acute health event in a hospital at home or hospital inpatient setting	2020	United Kingdom	Qualitative	Fall; Delirium	Patients and caregivers contributed to acute healthcare in both locations, often in parallel to healthcare providers. Our findings highlight an opportunity for CGA-guided services at the interface of acute and chronic condition management to facilitate personal, social and service strategies extending beyond an acute episode of healthcare.
Townson, J. Lowes, L. Robling, M. et al., [71]	Health professionals' perspectives on delivering home and hospital management at diagnosis for children with type 1 diabetes: A qualitative study from the Delivering Early Care in Diabetes Evaluation trial	2020	United Kingdom	Qualitative	Paediatric	A hybrid approach, of a brief stay in hospital and early home management, offers a pragmatic solution to the advantages and challenges presented by both systems.
Facultad, J. Lee, G. A. [58]	Patient satisfaction with a hospital-in-the-home service	2019	United Kingdom	Observational	Falls; Hyper-/hypotension, hyper-/hypoglycaemia; Hyponatraemia, hyperkalaemia and other electrolyte imbalances; Palliative care; Hyperemesis	The majority of respondents said they would recommend the @home service (n=200, 97%) and were very satisfied or satisfied with the service (n=203, 99%). Only 48 respondents provided qualitative free text comments, and overall, these were very positive and supportive of the @home service. The findings support the benefits of the @home model of care from the patients' perspective.
Saenger, Pamela M. Ornstein, Katherine A. Garrido, Melissa M. et al., [51]	Cost of home hospitalization versus inpatient hospitalization inclusive of a 30-day post-acute period	2022	USA	Observational	Dehydration	HaH combined with 30-day post-acute transition care was less costly than inpatient care.

Levine, D. M. Paz, M. Burke, K. Schnipper, J. L. [63]	Predictors and Reasons Why Patients Decline to Participate in Home Hospital: a Mixed Methods Analysis of a Randomized Controlled Trial	2022	USA	Randomised controlled trial	Asthma	Many patients declined because they felt it was easier to remain in the hospital (20%) or felt safer in the hospital than in their home (20%). CONCLUSIONS: Patients who declined to enroll in a home hospital intervention had similar sociodemographic characteristics as enrollees except partner status and declined most often for perceptions surrounding safety at home and the ease of remaining in the hospital.
Levine, D. M. Pian, J. Mahendrakumar, K. et al., [62]	Hospital-Level Care at Home for Acutely Ill Adults: a Qualitative Evaluation of a Randomized Controlled Trial	2021	USA	Qualitative	Asthma	Compared to control patients, home patients had better experiences with their care team, had more experiences promoting healing such as better sleep and physical activity, and had better experiences with systems factors such as the admission processes. Potential explanations include continuity of care, the power and familiarity of the home, and streamlined logistics. Future improvements include enhanced care transitions and ensuring digital interfaces are usable.
Ross, H. Dritz, R. Morano, B. et al., [54]	The unique role of the social worker within the Hospital at Home care delivery team	2021	USA	Observational	Dehydration	social worker is involved in 71% of admissions and plays a crucial role in pre-emergency department discharge home care and safety screening, home intake, follow-up support, and transition of care to primary care providers and community-based services. We describe the social work activities involved in this model of care and present composite case studies for further illustration.
Levine, D. M. Desai, M. P. Ross, J. et al., [84]	Rural Perceptions of Acute Care at Home: A Qualitative Analysis	2021	USA	Qualitative	Rural population	Significant interest and optimism exist surrounding rural home hospital despite perceived barriers. Designing for and testing adaptations to the urban model will likely optimize benefits and minimize threats to a potential intervention.
Giese-Kim, N. Wu, M. Dehghan, M. et al., [70]	Home Infliximab Infusions Are Associated With Suboptimal Outcomes Without Cost Savings in Inflammatory Bowel Diseases	2020	USA	Observational	IBS	In this analysis, home infliximab infusions for patients with IBD were associated with suboptimal outcomes including higher rates of nonadherence and discontinuation of infliximab. Home infusions did not result in significant cost savings compared with office infusions.
Saenger, P. Federman, A. D. DeCherrie, L. V. et al., [55]	Choosing Inpatient vs Home Treatment: Why Patients Accept or Decline Hospital at Home	2020	USA	Non-controlled trial / case study	Dehydration	Two-thirds of patients offered HaH care opted to receive it. The reasons for declining HaH provided by those who chose not to participate should be considered for quality improvement, and reasons for acceptance may be helpful in marketing and other efforts to promote HaH participation.
McFarlane, J. Liu, F. [80]	The Lived Experiences of Family Caregivers of Persons Dying in Home Hospice: Support, Advocacy,	2020	USA	Qualitative	Palliative care	We learned the decision to begin home hospice was made by a physician, followed frequently by family resistance and refusal to assist. Family caregiver burden is enormous, compounded by fatigue, sleeplessness, and confusion on issues such as morphine dosage and administration. The stages and process of dying, such as transition, baffled family caregivers. All

	and Information Urgently Needed					family caregivers agree financial and emotion support, empathic advocacy, and affirmation of their worth are needed to sustain them to care for the dying.
Cao, T. Johnson, A. Coogle, J. et al., [74]	Incidence and Characteristics Associated with Hospital Readmission after Discharge to Home Hospice	2020	USA	Observational	Palliative care	Compared with prior studies, our findings showed a lower incidence of readmission, 10.50%, from home hospice. In addition, those who are female, non-white, or have a hospice diagnosis of cardiac disease are more likely to be readmitted.
Levine, D. M. Ouchi, K. Blanchfield, B. et al., [61]	Hospital-Level Care at Home for Acutely Ill Adults: A Randomized Controlled Trial	2020	USA	Controlled trial	Asthma	Substitutive home hospitalization reduced cost, health care use, and readmissions while increasing physical activity compared with usual hospital care.
Brown, B. Weiss, J. L. Kolodny, S. et al., [47]	Analysis of cardiac monitoring and safety data in patients initiating fingolimod treatment in the home or in clinic	2019	USA	Observational	Multiple sclerosis	A substantial number of patients have initiated fingolimod at home, reporting very high levels of satisfaction. Gilenya@Home was as rigorous as the clinic setting in detecting cardiovascular events. Overall, FDO safety outcomes were similar with Gilenya@Home and in-clinic.
Wang, S. E. Liu, I. A. Lee, J. S. et al., [76]	End of Life Care in Patients Exposed to Home-Based Palliative Care vs Hospice Only	2019	USA	Observational	Palliative care	Earlier comprehensive palliative care in patients' home in place of or preceding hospice is associated with fewer hospitalizations and SNF stays and more time at home in the final 6 months of life.
Cai, S. Grubbs, A. Makineni, R. et al., [48]	Evaluation of the Cincinnati Veterans Affairs Medical Center Hospital-in-Home Program	2018	USA	Observational	Diabetic foot ulcer; complicated wound care	The substitutive HIH model implemented in the Cincinnati VAMC delivered acute services in veterans' homes at lower cost and with lower likelihood of post discharge nursing home use. Thirty-day readmission rates and mortality were not statistically different between HIH and non-HIH veterans. Broader implementation of this innovative delivery model may benefit older adults in need of care while reducing healthcare system costs.
Mann, E. Zepeda, O. Soones, T. et al., [52]	Adverse drug events and medication problems in "Hospital at Home" patients	2018	USA	Observational	Dehydration	We found 45 potential adverse drug events and 14 adverse drug events. None of the adverse drug events were severe. Some events, like problems with medication administration, may be unique to the hospital at home setting. Monitoring for adverse drug events is feasible and important for hospital at home programs.



Federman, A. D. Soones, T. DeCherrie, L. V. et al., [42]	Association of a Bundled Hospital-at-Home and 30-Day Postacute Transitional Care Program With Clinical Outcomes and Patient Experiences	2018	USA	Non-controlled trial / case study	Multiple - see table	HaH care bundled with a 30-day post-acute transitional care episode was associated with better patient outcomes and ratings of care compared with inpatient hospitalization. This model warrants consideration for addition to Medicare's current portfolio of shared savings programs.
Pinderhughes, S. T. Lehn, J. M. Kamal, A. H. et al., [72]	Expanding Palliative Medicine across Care Settings: One Health System Experience	2018	USA	Observational	Palliative care	By utilizing these strategies and concepts, Palliative Care can successfully expand outside hospital walls to serve high-risk, high-cost patient populations.
Cai, S. Laurel, P. A. Makineni, R. Marks, M. L. [49]	Evaluation of a Hospital-in-Home Program Implemented Among Veterans	2017	USA	Observational	Geriatrics	This study provides evidence of the potential benefits of a model that delivers acute care in patients' homes. Considering the emergence of accountable healthcare organizations, interest in broader implementation of such programs may be worthy of investigation.

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