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Alternative Strategies to Inpatient Hospitalization for Acute Medical Conditions
A Systematic Review

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IMPORTANCE Determining innovative approaches that better align health needs to the appropriate setting of care remains a key priority for the transformation of US health care; however, to our knowledge, no comprehensive assessment exists of alternative management strategies to hospital admission for acute medical conditions.

OBJECTIVE To examine the effectiveness, safety, and cost of managing acute medical conditions in settings outside of a hospital inpatient unit.

EVIDENCE REVIEW MEDLINE, Scopus, CINAHL, and the Cochrane Database of Systematic Reviews (January 1995 to February 2016) were searched for English-language systematic reviews that evaluated alternative management strategies to hospital admission. Two investigators extracted data independently on trial design, eligibility criteria, clinical outcomes, patient experience, and health care costs. The quality of each review was assessed using the revised AMSTAR tool (R-AMSTAR) and the strength of evidence from primary studies was graded according to the Oxford Centre for Evidence-Based Medicine.

FINDINGS Twenty-five systematic reviews (representing 123 primary studies) met inclusion criteria. For outpatient management strategies, several acute medical conditions had no significant difference in mortality, disease-specific outcomes, or patient satisfaction compared with inpatient admission. For quick diagnostic Units, the evidence was more limited but did demonstrate low mortality rates and high patient satisfaction. For hospital-at-home, a variety of acute medical conditions had mortality rates, disease-specific outcomes, and patient and caregiver satisfaction that were either improved or no different compared with inpatient admission. For observation units, several acute medical conditions were found to have no difference in mortality, a decreased length of stay, and improved patient satisfaction compared to inpatient admission; results for some conditions were more limited. Across all alternative management strategies, cost data were heterogeneous but showed near-universal savings when assessed.

CONCLUSIONS AND RELEVANCE For low-risk patients with a range of acute medical conditions, evidence suggests that alternative management strategies to inpatient care can achieve comparable clinical outcomes and patient satisfaction at lower costs. Further study and application of such opportunities for health system redesign is warranted.

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Supplemental content

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The US health care system is in the midst of transformation as it seeks to improve the health outcomes of populations and individual patients at an affordable cost. One important area of redesign is identifying the best management setting for the diagnosis and/or treatment of acute medical conditions—particularly as it relates to hospital-based care, which accounts for the largest share of total US health care costs (32.4% in 2014).[1] Conventionally, many acute medical conditions have been managed in a hospital inpatient setting; however, innovative care delivery models are challenging the status quo, often with the support of biotechnological advancement. These newer approaches suggest that safe, alternative management strategies exist that obviate the need for inpatient admission.[2-4]

These management approaches are currently organized into 4 models of care delivery: (1) outpatient management—emergency department (ED) or clinic workup and treatment with close outpatient follow-up; (2) quick diagnostic units (QDUs)—organized clinics that obtain rapid diagnoses for serious illnesses (eg, malignant neoplasm); (3) hospital-at-home (HaH)—evaluation in the ED or clinic, followed by delivery of inpatient-level care within the patient's home[3,5]; and (4) observation units—protocol-driven management for up to 24 to 48 hours within a dedicated space with subsequent discharge for outpatient follow-up.[4] Most of these models of care have been in various phases of development for decades (albeit with notable spread to additional conditions in recent years); QDUs, however, were devised more recently in the mid-2000s.

To date, several systematic reviews of alternative management strategies have been completed; however, the scope of these reviews have been limited to either a single condition or a single strategy. Therefore, we sought to comprehensively review all pertinent systematic reviews to better characterize the state of the science of these alternative management strategies—with regard to their ability to safely achieve high-quality clinical outcomes, greater patient satisfaction, and lower cost.

Methods

We searched MEDLINE, Scopus, CINAHL, and the Cochrane Database of Systematic Reviews (January 1, 1995, to February 4, 2016) for systematic reviews that examined the use of alternative management strategies. Our search strategy made use of various combinations of terms for alternative care delivery settings and management strategies, and was limited by "systematic review" and English language (see eMethods in the Supplement). We also manually reviewed the references of the included studies, reached out to subject-matter experts, and searched relevant gray literature.

We defined the following a priori inclusion criteria: (1) evaluated 1 or more acute medical condition(s) conventionally managed in an inpatient hospital unit; (2) focused on evaluating the efficacy or effectiveness of managing such a condition using an alternative management strategy that avoided hospital admission; (3) reviewed at least 2 studies, either randomized clinical trials (RCTs) or observational studies;and (4) evaluated adults 18 years or older. We excluded studies of "early-discharge" management strategies and studies focusing exclusively on obstetric, surgical, and psychiatric populations. When feasible, we also excluded "early-discharge" data from within qualified reviews that assessed multiple different management strategies. For the review process, titles were reviewed by 1 author and abstracts and full-text articles were reviewed independently by 2 authors (J.C., C.O.). Disagreements regarding inclusion in the final review were resolved through discussion or by seeking consensus with a third reviewer (D.Z.). Data extraction was performed independently by 2 reviewers (J.C., C.O.). The methodological quality of each systematic review was evaluated by one reviewer (C.O.) using the R-AMSTAR checklist[6] and verified by a second reviewer (J.C.). The strength of evidence from each primary study was graded according to the Oxford Centre for Evidence-Based Medicine levels of evidence by 2 reviewers independently (J.C., C.O.), with discrepancies resolved through discussion.[7]

Results

Out of 18 113 articles meeting search criteria, there were 25 systematic reviews—representing 123 unique primary studies—that met all eligibility criteria and were included for data abstraction (see eFigure and eTable 1 in the Supplement).[8-32] For evidence synthesis, 3 systematic reviews[30-32] were ultimately not used given their lack of unique primary studies owing to more updated systematic reviews.

Table 1 describes the general characteristics of each included systematic review. For outpatient management, there were 11 qualifying systematic reviews that examined pulmonary embolism (PE) (n = 4),[8-11] deep vein thrombosis (DVT) (n = 1),[12] chemotherapy-induced febrile neutropenia (CIFN) (n = 2),[13,14] community-acquired pneumonia (CAP) (n = 1),[15] pneumothorax (n = 1),[16] renal colic (n = 1),[18] and diverticulitis (n = 1).[17] For QDUs, there was 1 qualifying systematic review that evaluated malignant neoplasms and a variety of other clinical conditions.[19] For HaH, there were 6 qualifying systematic reviews that examined acute exacerbations of heart failure (n = 1)[20] and chronic obstructive pulmonary disease (COPD) (n = 2),[24,25] as well as a variety of other clinical conditions (n = 3).[21-23] For observation units, there were 4 qualifying systematic reviews that examined multiple clinical conditions (n = 3),[26-28] as well as chest pain individually (n = 1).[29]

Patient eligibility varied across studies. For outpatient management and observation units, patients qualified for lower-intensity management strategies if they were identified as low-risk based on clinical and social criteria. For HaH, individuals met home management criteria if they required inpatient care for a qualifying condition, had adequate home circumstances, and accepted this form of acute management.

In general, the methodological quality of the systematic reviews was moderate with an average R-AMSTAR score of 31 out of 44 (Table 1 and eTable 2 in the Supplement). Systematic reviews focusing on outpatient management and HaH were given the highest quality ratings. The main area of weakness for these systematic reviews was a failure to report potential publication bias, along with a limited amount of meta-analyses for outpatient reviews. Systematic reviews focusing on observation unit settings had additional limitations owing to inadequate search comprehensiveness, incomplete reporting of publication bias, and limited quality assessment—with the exception of the most recent review.[26] The strength of evidence from primary studies was varied. For outpatient management and QDUs, most of the evidence came from level 4 observational studies (often owing to a lack of inpatient

Table 1. Characteristics and Quality of the Systematic Reviews

Strategy and Condition	Systematic Review	Relevant Studies, No.[a]	Study Design (No.)	Relevant Primary Studies by Evidence Level	R-AMSTAR Quality Rating (44 Points Total)
Outpatient management					
PE	Zondag et al,[8] 2013	14	RCT (3), observational (11)	1 Level 1b study, 2 level 1b− studies, 11 level 4 studies	Moderate (32)
	Piran et al,[9] 2013	9	RCT (3), observational (6)	1 Level 1b study, 2 level 1b− studies, 6 level 4 studies	High (35)
	Vinson et al,[10] 2012	8	RCT (2), observational (6)	1 Level 1b study, 1 level 1b− study, 1 level 2b study, 5 level 4 studies	High (35)
	Squizzato et al,[11] 2009	8	RCT (1), observational (7)	1 Level 1b− study, 7 level 4 studies	Moderate (30)
CIFN	Mamtani and Conlon,[13] 2014	3	RCT (2), observational (1)	1 Level 1b study, 1 level 1b− study, 1 level 4 study	Low (23)
	Carstensen and Sørensen,[14] 2008	9	RCT (4), observational (5)	4 Level 1b− studies, 5 level 4 studies	Low (23)
CAP	Chalmers et al,[15] 2011	6	RCT (3), observational (3)	1 Level 1b− study, 4 level 2b studies, 1 level 4 studies	High (36)
Pneumothorax	Brims and Maskell,[16] 2013	13	RCT (10), observational (3)	1 Level 2b study, 12 level 4 studies	Moderate (31)
DVT	Lane and Harrison,[12] 2000	4	Observational (4)	4 Level 4 studies	Low (21)
Diverticulitis	Jackson and Hammond,[17] 2014	7	Observational (7)	1 Level 2b study, 6 level 4 studies	Moderate (31)
Renal colic	Stewart ,[18] 2012	3	Observational (3)	3 Level 4 studies	Low (21)
QDU					
Various medical conditions (eg, malignant neoplasm, unexplained anemia)	Gupta et al,[19] 2014	5	Observational (5)	1 Level 2b study, 4 level 4 studies	Moderate (31)
HaH					
Heart failure exacerbation	Qaddoura et al,[20] 2015	5	RCT (3), observational (2)	2 Level 1b− studies, 1 level 2b study, 2 level 4 studies	High (40)
Various medical conditions (eg, pneumonia, urosepsis, cellulitis)	Varney et al,[21] 2014	16	RCT (9), observational (7)	5 Level 1b− studies, 3 level 2b studies, 1 level 2c study, 7 level 4 studies	Moderate (32)
	Caplan,[22] 2012	26	RCT (26)	19 Level 1b− studies, 6 level 2b studies, 1 level 4 study	Moderate (31)
	Shepperd et al,[23] 2009	11	RCT (11)	7 Level 1b− studies, 3 level 2b studies, 1 level 4 study	High (35)
COPD exacerbation	Jeppesen et al,[24] 2012	8	RCT (8)	5 Level 1b− studies, 2 level 2b studies, 1 level 4 study	High (40)
	McCurdy,[25] 2012	2	RCT (2)	2 Level 1b− studies	Moderate (31)
Observation unit					
Various medical conditions (eg, chest pain, atrial fibrillation, asthma)	Galipeau et al,[26] 2015	5	RCT (5)	4 Level 1b− studies, 1 level 2b study	High (40)
Chest pain, asthma	Daly et al,[27] 2003	4	RCT (4)	1 Level 1b− study, 3 level 1b studies	Moderate (27)
Various medical conditions (eg, asthma, COPD, pyelonephritis)	Cooke et al,[28] 2003	7	RCT (2), observational (5)	1 Level 1b− study, 1 level 1b study, 5 level 4 studies	Low (21)
Chest pain	Goodacre,[29] 2000	9	RCT (4), observational (5)	4 Level 1b− studies, 1 level 2b study, 4 level 4 studies	Low (24)

Abbreviations: CAP, community-acquired pneumonia; CIFN, chemotherapy-induced febrile neutropenia; COPD, chronic obstructive pulmonary disease; DVT, deep vein thrombosis; HaH, hospital-at-home; PE, pulmonary embolism; QDU, quick diagnostic unit; R-AMSTAR, revised AMSTAR tool; RCT, randomized clinical trial.

[a] In some cases, primary studies appeared in more than 1 review within the same clinical category (see eTable 3 in the Supplement for more details).

comparison), along with some level 1b and 2b studies. For HaH, the evidence largely came from level 1b and 2b RCTs. For observation units, evidence came from a mix of level 1b and 4 studies (Table 1 and eTable 3 in the Supplement).

Outpatient Management

Clinical Outcomes

Compared with hospitalization, outpatient management (after appropriate ED or clinic workup) demonstrated no significant differences in mortality for low-risk PE, CIFN, and CAP.[8,9,13-15] For low-risk DVT and pneumothorax, no inpatient comparison data were available, but overall mortality rates were less than 1.2%.[12,16] No mortality data were available in the renal colic or diverticulitis systematic reviews, likely owing to the lower acuity of these conditions.[17,18] Return hospitalization rates (ie, admissions following outpatient management or readmissions following inpatient management) were reported in reviews of diverticulitis (3.4%) and CIFN (14%-21%), but were compared across outpatient and inpatient management only

for CAP (no significant difference).[13-15,17] Additional disease-specific outcomes demonstrated overall low complication rates with no significant differences between outpatient and inpatient management (**Table 2**).

Patient and Caregiver Experience

Patient and caregiver satisfaction with outpatient management was high for all conditions that evaluated these outcomes (DVT, PE, CAP). Although there was limited evidence comparing outpatient vs inpatient management strategies, studies of PE and CAP suggest no significant differences in satisfaction (**Table 3**).[10,12,15]

Costs

The 2 systematic reviews (on pneumothorax and diverticulitis) that assessed the financial impact of outpatient vs inpatient management suggest significant cost savings (Table 3).[16,17]

Quick Diagnostic Units

Clinical Outcomes

Data on mortality were limited in this care model; there was no comparison to inpatient admission, but 1 large prospective trial of 4170 patients showed a mortality rate of 0.3%. Return hospitalization rates (ie, necessary admissions following QDU management) varied from 3% to 10%. Time from initial contact to diagnosis ranged from 6 to 11 days across each QDU cohort (Table 2).[19]

Patient and Caregiver Experience

Patient satisfaction with the QDU model was high among all studies that evaluated this metric. Notably, 1 primary study found that when compared with inpatient admission, 88% preferred QDU-based care. Two other studies, which did not have inpatient comparison groups, reported very high satisfaction with QDU care (95%-97% of patients) (Table 3).[19]

Costs

Two primary studies demonstrated savings of $2353 to $3304 per patient for those in the QDU model compared with inpatient matched controls. Another study showed a potential economic saving of 4.5 inpatient beds per day but did not include specific cost-savings data (Table 3).[19]

Hospital-at-Home

Clinical Outcomes

Across many acute medical conditions (including heart failure and COPD exacerbations, cellulitis, CAP, PE, and stroke), 4 reviews[20,21,24,25] showed no significant difference in mortality in HaH management compared with conventional inpatient admission, while 2 reviews[22,23] showed a significant decrease in mortality in HAH management. Return hospitalization rates (ie, admissions following HaH or readmissions following inpatient management) were found to be unchanged,[20,21,23,25] except in 1 review of COPD exacerbations and another review of various medical conditions, where HaH was associated with lower return hospitalization rates.[22,24] Additional patient outcomes demonstrated no significant differences in functional ability, quality of life, or disease-specific outcomes for all reviews, except 1 in which HaH management of exacerbations of heart failure demonstrated significantly improved health-related quality of life (Table 2).[20]

Patient and Caregiver Experience

Hospital-at-home management was associated with higher patient satisfaction in the 3 reviews[21-23] of multiple conditions, while no significant difference was seen in patients with COPD exacerbations.[24,25] A review on HaH for heart failure exacerbations showed high patient satisfaction (96%); however, there was no inpatient comparison group.[20] Evidence on caregiver satisfaction was limited to data from 4 reviews[21-24] and showed modest but significantly higher satisfaction for all conditions except COPD, for which caregiver satisfaction was unchanged (Table 3).

Costs

One meta-analysis of 5 studies covering several clinical conditions found that HaH saved an average of just under $2000 per patient when compared with inpatient management.[22] Two other systematic reviews also covering various clinical conditions found statistically significant cost savings for HaH, but these reviews excluded costs of informal and related care.[21,23] A review of HaH for exacerbations of heart failure showed unanimous short-term savings across 3 studies; follow-up costs at 1 year were significantly lower in 1 study and nonsignificantly lower in another[20,24] (Table 3).

Observation Unit

Clinical Outcomes

Mortality data in observation unit management were evaluated for asthma, chest pain, and atrial fibrillation and found no difference between intervention and inpatient admission groups.[26,29] Return hospitalization rates (ie, admissions following observation unit care or readmissions following inpatient management) were found to be significantly lower in 1 primary study of chest pain observation units, while 2 other primary studies reported a nonsignificant increase for chest pain units.[26,29] Other disease-specific outcomes were found to be either equal or improved in observation units compared with hospital admission (Table 2).

Patient and Caregiver Experience

Observation units were associated with increased patient satisfaction when compared with inpatient management strategies.[26-28] None of the reviews examined family or caregiver satisfaction with observation units (Table 3).

Costs

Chest pain observation units resulted in cost-savings ranging from $567 to $1873 per patient compared with conventional inpatient management.[29] Two other reviews[26,28] of observation unit use for a variety of medical conditions found reduced costs. Limited evidence was available for observation unit management of asthma (1 primary study)—it showed the mean (SD) observation unit costs of $1203 ($1344) compared with inpatient costs of $2247 ($1110) (Table 3).[27]

Discussion

Understanding the safety, efficacy, and costs of managing acute medical conditions in alternative care delivery settings to inpatient admission is critically important as the US health care system attempts to identify affordable mechanisms for improving individual

Table 2. Clinical Outcomes of Alternative Management Strategies

Strategy and Condition	Systematic Review	Mortality		Return Hospital Admissions		Additional Clinical Outcomes
		Summary	Details	Summary	Details	
Outpatient management						
PE	Zondag et al,[8] 2013	↔	1.94% In outpatients (13 studies; 95% CI, 0.79-4.84) and 0.74% in inpatients (5 studies; 95% CI, 0.04-11.14)	NA	NR	Major bleeding risk in outpatients was 0.97% (12 studies; 95% CI, 0.58-1.59) and in inpatients was 1.04% (5 studies; 95% CI, 0.39-2.75); recurrent VTE risk in outpatients was 1.70% (13 studies; 95% CI, 0.92-3.12) and in inpatients was 1.18% (4 studies; 95% CI, 0.16-8.14)
	Piran et al,[9] 2013	↔	1.58% In outpatients (9 studies; 95% CI, 0.71-2.80) and 3.67% in inpatients (2 studies; 95% CI, 0.02-15.15)	NA	NR	Recurrent VTE risk in outpatients was 1.47% (9 studies; 95% CI, 0.47-3.0), major bleeding was 0.81% (9 studies; 95% CI, 0.37-1.42) and fatal ICH was 0.29% (9 studies; 95% CI, 0.06-0.68)
	Squizzato et al,[11] 2009	NA	0% At 7-10 d in outpatients (3 studies); VTE-related mortality at 3-13 mo occurred in 1 outpatient, owing to major bleeding (7 studies), and no inpatients (2 studies)	NA	NR	Recurrent VTE at 7-10 d in outpatients was 0%-1.5% and major bleeding was 0%-2.3% (3 studies); recurrent VTE at 3-13 mo in outpatients ranged from 0% to 8.7% and major bleeding was 0%-2.7% (7 studies); recurrent VTE ranged from 3.2% to 9.3% in inpatients, and there was no major bleeding (3 studies)
CIFN	Mamtani and Conlon,[13] 2014	↔	No difference in mortality between outpatient and inpatient groups (2 RCTs); 0% in both groups in a retrospective study	NA	17%-21% In outpatients (3 studies)	Success rate in outpatient oral therapy was 89.5% and in inpatient IV therapy was 91% in an RCT; initial response to treatment in outpatients was 81% and in inpatients was 80% in a retrospective study
	Carstensen and Sørensen,[14] 2008	↔	No significant difference between outpatients and inpatients (3 studies)	NA	14% In outpatients (9 studies).	Treatment response in outpatients was not inferior to inpatients, regardless of antibiotic administration route
CAP	Chalmers et al,[15] 2011	↔	OR for outpatients compared with inpatients was 0.83 (6 studies; 95% CI, 0.59-1.17)	↔	OR for outpatients compared with inpatients was 1.08 (6 studies; 95% CI, 0.82-1.42)	Return to work and usual activities did not differ between inpatients and outpatients (2 studies); there was also no difference between health-related QOL (2 studies)
Pneumothorax	Brims and Maskell,[16] 2013	NA	0% in outpatients (13 studies)	NA	NR	Successful treatment using Heimlich valve was 77.9% in outpatients (13 studies; 95% CI, 75.2%-80.4%)
DVT	Lane and Harrison,[12] 2000	NA	1.1% VTE-related mortality in one study, no VTE related death in another (2 studies)	NA	NR	DVT recurrence ranged from 0% to 5.6% (4 studies)
Diverticulitis	Jackson and Hammond,[17] 2014	NA	NR	NA	3.4% In outpatients (7 studies)	4 Days of oral therapy resulted in resolution of symptoms in 95% of outpatients (1 study)
Renal colic	Stewart,[18] 2012	NA	NR	NA	NR	Incidence of complications was 0% (3 studies); proportion of patients able to be safely discharged home ranged from 33% to 75% (2 studies); 54% of patients were discharged in another study
QDU						
Various medical conditions (eg, malignant neoplasm, unexplained anemia)	Gupta et al,[19] 2014	NA	0.3% In QDU cohort (1 study)	NA	3%-10% In QDU cohort (3 studies)	Time from initial contact to diagnosis ranged from 6 to 11 d (5 studies); the most common final diagnosis was malignant neoplasm; range, 15% to 30% of diagnoses (4 studies)

(continued)

Table 2. Clinical Outcomes of Alternative Management Strategies (continued)

Strategy and Condition	Systematic Review	Mortality		Return Hospital Admissions		Additional Clinical Outcomes
		Summary	Details	Summary	Details	
HaH						
Heart failure	Qaddoura et al,[20] 2015	↔	RR for HaH compared with inpatients was 0.94 (3 studies; 95% CI, 0.67-1.32); mortality was 3.8% in HaH and 9.7% in inpatients in a prospective cohort study ($P < .05$)	↔	RR for HaH compared with inpatients was 0.68 in RCTs (2 studies; 95% CI, 0.42-1.09); return admissions were significantly lower in prospective cohort trials (2 studies)	Health-related QOL was significantly improved at 6 mo, standard mean difference in HaH was −0.31 (2 studies; 95% CI, −0.45 to −0.18); this measure was also improved at 12 mo in another study
Various medical conditions (eg, pneumonia, urosepsis, cellulitis)	Varney et al,[21] 2014	↔	No difference between HaH and inpatient care (5 studies)	↔	No difference between HaH and inpatient in RCTs (3 studies); 0%-15% in observational studies (5 studies)	Clinical outcomes (4 studies), QOL (3 studies) and adverse events or complications (3 studies) did not differ between HaH and inpatient care
Various medical conditions (eg, COPD, stroke, pulmonary embolism)	Caplan et al,[22] 2012	↓	OR for HaH compared with inpatients was 0.79 (23 studies; 95% CI, 0.65-0.97)	↓	OR for HaH compared with inpatients was 0.76 (18 studies; 95% CI, 0.60-0.97)	NR
Various medical conditions (eg, COPD, stroke, cellulitis, pneumonia)	Shepperd et al,[23] 2009	↓	Hazard ratio for HaH compared with inpatients at 3 mo was 0.77 (5 studies; 95% CI, 0.54-1.09); at 6 mo it was 0.62 (3 studies; 95% CI, 0.45-0.87)	↔	RR for HaH compared with inpatients was 1.35 (5 studies; 95% CI, 0.97-1.87); patient-level meta-analysis had hazard ratio of 1.49 (3 studies; 95% CI, 0.96-2.33)	Functional ability was not significantly different at 3, 6, and 12 mo between HaH and inpatient groups (5 studies); QOL measurements did not differ (3 studies)
COPD	Jeppesen et al,[24] 2012	↔	RR for HaH compared with inpatients was 0.65 (7 studies; 95% CI 0.40-1.04)	↓	RR for HaH compared with inpatients was 0.76 (8 studies; 95% CI, 0.59-0.99)	FEV1 in HaH compared with inpatients had standardized mean difference of 0.13 (3 studies; 95% CI, −0.10 to 0.36)
	McCurdy,[25] 2012	↔	RR for HaH compared with inpatients was 0.85 (2 studies; 95% CI, 0.45-1.62)	↔	RR for HaH compared with inpatients was 0.79 (2 studies; 95% CI, 0.43-1.45)	Mean percentage predicted FEV1 after bronchodilator use was 36% in HaH compared with 35% in inpatients (1 study)
Observation unit						
Various medical conditions (eg, chest pain, atrial fibrillation, asthma)	Galipeau et al,[26] 2015	↔	0% In observation units and inpatients (4 studies)	↔	8% In short stay unit and 23% in inpatients in 1 study ($P = .03$) and no difference in another study	No adverse events in 2 studies and no difference in adverse events between observation units and inpatients in a third study; length of stay was shorter in short stay units (4 studies)
Chest pain, asthma	Daly et al,[27] 2003	NA	NR	NA	NR	No difference in cardiac events between a chest pain unit and inpatients (1 study); peak flow and relapse-free survival was equivalent in an asthma observation unit compared with inpatients (1 study)
Various medical conditions (eg, asthma, COPD, pyelonephritis)	Cooke et al,[28] 2003	NA	NR	↔	No difference in an asthma observation unit compared with inpatients (1 study); no change in admissions with an asthma observation unit in another study	NR
Chest pain	Goodacre,[29] 2000	↔	No significant difference between observation unit and inpatients (5 studies)	↔	6.1%-8% For observation units and 4.2%-4.5% for inpatients, with no significant difference between groups (2 studies)	Acute myocardial infarction (range, 0%-4.9%) and did not differ between observation unit and inpatient management

Abbreviations: CAP, community-acquired pneumonia; CIFN, chemotherapy-induced febrile neutropenia; COPD, chronic obstructive pulmonary disease; DVT, deep vein thrombosis; FEV1, forced expiratory volume in 1 second; HaH, hospital-at-home; ICH, intracranial hemorrhage; IV, intravenous; NA, no available evidence, or no inpatient control group with which to compare the intervention; NR, not reported; OR, odds ratio; PE, pulmonary embolism; QDU, quick diagnostic unit; QOL, quality of life; RR, risk ratio; VTE, venous thromboembolism; ↔, outcome did not differ between intervention group and inpatient control group; ↓ outcome was decreased in intervention group compared with inpatient control group.

Table 3. Patient Satisfaction and Costs of Care of Alternative Management Strategies

Strategy and Condition	Systematic Review	Patient Satisfaction		Costs of Care	
		Summary	Details	Summary	Details[a]
Outpatient management					
Pulmonary embolism	Vinson et al,[10] 2012	↔	No difference between inpatient and outpatients in 1 RCT (P = .39); more inpatients preferred home therapy than outpatients preferred inpatient care	NA	NR
CAP	Chalmers et al,[15] 2011	↔	OR of outpatients compared with inpatients was 1.21 (3 studies; 95% CI, 0.97-1.49)	NA	NR
Pneumothorax	Brims and Maskell,[16] 2013	NA	NR	↓	Use of Heimlich valve in outpatients compared with intracostal catheter use in inpatients resulted in cost ratios of 1:3.5 and 1:5 (2 studies; 2006, 1980)
Deep vein thrombosis	Lane and Harrison,[12] 2000	NA	91% Of outpatients were pleased with home treatment (1 study)	NA	NR
Diverticulitis	Jackson and Hammond,[17] 2014	NA	NR	↓	35.0%-83.0% Cost savings in outpatients (4 studies; 2009, 2006, 2002)
QDU					
Various medical conditions (eg, malignant neoplasm, unexplained anemia)	Gupta et al,[19] 2014	NA	Preference for QDU care over hospitalization was 88% (1 study); 95%-97% of patients in 2 other studies reported very high satisfaction with QDU care	↓	$2353-$3304 Per patient cost savings in the QDUs (2 studies; 2012, 2001)
HaH					
Heart failure	Qaddoura et al,[20] 2015	NA	96% Of patients were very satisfied or satisfied with HaH care (1 study)	↓	Significantly reduced costs in outpatients in RCTs (3 studies; 2008, 2007, 2005); costs at 12 mo remained significantly lower in 1 RCT and were lower in another RCT but not statistically significant
Various medical conditions (eg, pneumonia, urosepsis, cellulitis)	Varney et al,[21] 2014	↑	Satisfaction was greater in HaH compared with inpatients in RCTs (3 studies); 1 RCT reported high HaH satisfaction; 95% of patients were satisfied in observational studies (2 studies)	↓	Significantly reduced costs in HaH in RCTs (3 studies; 2000, 1997); other studies reported savings without a P value (2 studies; 1999, 1998)
Various medical conditions (eg, COPD, stroke, pulmonary embolism)	Caplan,[22] 2012	↑	Satisfaction was greater in HaH compared with inpatients in all but 1 study, in which satisfaction was equal (10 studies)	↓	Cost savings favored HaH with mean difference of −1821.69 in RCTs (5 studies; 2008; 95% CI, −2591.89 to −1051.49)
Various medical conditions (eg, COPD, stroke, cellulitis, pneumonia)	Shepperd et al,[23] 2008	↑	Higher satisfaction in HaH compared with inpatients: cellulitis (P < .001) and CAP (40% more); elderly patients with various medical conditions also reported significantly higher satisfaction in HaH (2 studies); in 1 study, 6% of patient refused HaH care	↓	Significant and nonsignificant cost savings were found in HaH when compared with inpatient care (6 studies; 2003, 2000, 1998, 1996)
COPD	Jeppesen et al,[24] 2012	↔	Risk ratio of HaH compared with inpatients was 1.06 (2 studies; 95% CI, 0.96-1.17)	↓	Significant reduction in direct costs for HaH in 2 studies, and 1 other study showed a trend toward lower cost without significance (3 studies; 2005, 2000)
	McCurdy,[25] 2012	↔	95% Of patients completely satisfied with care in HaH (1 study); 94% of patients in HaH and 88% of inpatients rated care as very good/excellent (1 study)	NA	NR

(continued)

patient and population health. In our study of alternative management strategies for acute medical conditions conventionally thought to require inpatient admission, we found moderate evidence of opportunities for safe and effective health system redesign, although further evaluation is required in some cases. For outpatient management strategies, several acute medical conditions showed no significant difference in mortality, disease-specific outcomes, patient satisfaction—and also showed significant cost savings. For QDUs, the evidence was more limited but did show low mortality rates, high patient satisfaction, and lower costs than inpatient admission. For HaH management, a variety of acute medical conditions demonstrated mortality rates, disease-specific outcomes, and patient and caregiver satisfaction that were either improved or no different compared with inpatient admission; costs were universally lower. Finally,

Table 3. Patient Satisfaction and Costs of Care of Alternative Management Strategies (continued)

Strategy and Condition	Systematic Review	Patient Satisfaction		Costs of Care	
		Summary	Details	Summary	Details[a]
Observation unit					
Various medical conditions (eg, chest pain, atrial fibrillation, asthma)	Galipeau et al,[26] 2015	↑	Satisfaction was significantly higher in observation units compared with inpatients in RCTs (2 studies)	↓	Significantly lower costs in observation units compared with inpatients in RCTs, 1 of which reported no difference in total revenue (3 studies; 2014)
Chest pain, asthma	Daly et al,[27] 2003	↑	Satisfaction was higher in a chest pain unit compared with inpatients in an RCT (1 study); satisfaction was higher in another RCT comparing an asthma observation unit to inpatients (1 study)	↔	Observation unit costs were $1203 ± $1344 compared with mean (SD) inpatient care costs of $2247 ($1110) (1 study; 1998)
Various medical conditions (eg, asthma, COPD, pyelonephritis)	Cooke et al,[28] 2003	↑	An asthma RCT showed the observation unit scored higher on all 7 care satisfaction measures and significantly greater for 4 measures (1 study)	↓	Cost savings in observation units compared with inpatients for chest pain, asthma, abdominal trauma (4 studies;1988, 1986, 1984, 1980); another study on asthma found no savings (1 study; 1990)
Chest pain	Goodacre, 2000[29]	↑	Satisfaction was higher in chest pain observation unit compared with inpatients (1 study)	↓	Cost savings in observation units ranged from $567-$1873 (7 studies; 1991-1996, 1988)

Abbreviations: CAP, community-acquired pneumonia; COPD, chronic obstructive pulmonary disorder; HaH, hospital-at-home; NA, no available evidence, or no inpatient control group with which to compare the intervention; NR, not reported; OR, odds ratio; QDU, quick diagnosis unit; RCT, randomized clinical trial.

↔ Outcome did not differ between intervention group and inpatient control group. ↓ Outcome was decreased in intervention group compared with inpatient control group. ↑Outcome was increased in intervention group compared with inpatient control group.

[a] The year of cost estimates are reported for each study. (In the limited cases where this was not provided, we reported the last year of patient enrollment.)

for observation units, several acute medical conditions were found to have no difference in mortality, a decreased length of stay, as well as improved patient satisfaction. Results for other acute medical conditions in observation unit settings were more limited, but costs were generally lower. Across all these alternative management strategies, the 1 notable exception to equal or improved outcomes was return hospitalizations for QDUs and outpatient management of CIFN, highlighting the need for improved low-risk stratification and strict return precautions when used. It should also be noted that, as a result of the Medicare Readmissions Reduction Program, hospital readmissions for Medicare patients have slightly decreased since its introduction, which might further affect this finding.[33]

Recommendations from guideline documents are consistent with our findings.[34-38] Despite the promise of alternative management strategies, the overall uptake remains low in many parts of the United States[39,40] and internationally.[41] In the United States, this is likely due, in part, to residual fee-for-service models, in which hospitals potentially lose revenue by delivering care in lower-cost settings. However, with the recent uptake of risk-sharing models of care delivery (eg, accountable care organizations, bundled payments) that are structured to better coordinate care across inpatient and outpatient settings, these alternative management strategies are likely to appeal to patients, clinicians, and organizational leadership alike.

With our unit of analysis being systematic reviews, a limited number of recent primary studies are not included in this review and deserve mention. Recent studies on outpatient management of diverticulitis,[42] pneumothorax,[43] HaH for respiratory infections in patients with neuromuscular disease,[44] and a QDU for unexplained peripheral lymphadenopathy[45] reached similar conclusions to those found in our study. As for observation unit management, with the most recent systematic review evaluating only RCTs,[26] several recent prospective cohort studies have not been included in the systematic reviews to date. A narrative review by Baugh et al,[46] however, corroborates our findings and adds further conditions (eg, transient ischemic attack, heart failure exacerbations) that show promising results regarding safety and efficacy. Another study[47] performed a systematic review that focused solely on the cost of observation unit management vs hospitalization and showed an average cost savings of $1572 per patient and the estimated potential for $3.1 billion in annual savings if observation units were implemented more broadly in the United States.

There are some limitations of this review. First, as noted herein, the evidence for some alternative management strategies (with the exception of HaH) is moderate owing to the lack of significant level 1 evidence; as such, some caution should be used to interpret these results. However, high-quality observational studies are important for analyzing these alternative management strategies, especially for rare events such as mortality and serious complications—where carrying out a sufficiently powered RCT may be impractical. Second, the interventions themselves often differed considerably within each management strategy (outpatient, QDU, HaH, and observation unit). Unlike a device or drug intervention, health care process interventions often have to be adapted to each particular setting and are, by nature, more varied. Nonetheless, this should not deter clinicians, researchers, and policymakers from drawing appropriate conclusions about the overall efficacy of such interventions. As stated by Shepperd et al,[23] the external validity of these findings is limited less by the challenge to define the exact intervention—a common difficulty in other trials of complex interventions—and more by the identification of the eligible populations for these newer management strategies. In addition, it speaks to their broad feasibility, as adaptations to each unique intervention setting (eg, in terms of population size and wealth) did not result in different overall outcomes. Third, the countries represented in these systematic reviews were diverse, and it is impor-

tant to account for relevant differences in health care delivery systems when assessing US or global applicability.[48] Such differences, however, should not inappropriately restrict what Mulley[49] refers to as "cross-border learnings"—the ability to adapt and adopt the best practices of nations beyond our own.

Our review highlights several opportunities for future research. For conditions and management strategies with limited level 1 evidence, additional evaluation is needed to validate findings from low-quality RCTs and observational studies. There is also a critical need to determine optimal patient eligibility for alternative management strategies. For many conditions, clinician experts and innovators have thoughtfully developed eligibility criteria for each condition/strategy (including social factors, such as home support and distance from hospital), but certain risk-stratifying algorithms require further evaluation and validation.

Conclusions

Our findings of alternative management strategies for low-risk patients with acute medical conditions conventionally treated via hospitalization suggest that safe and effective care can be achieved in lower cost settings with positive or neutral impact on patient satisfaction. Further examination with RCT and high-quality comparative observational studies for some conditions and models of care is warranted.

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