Supplemental Appendix

Appropriateness of Long-Term Acute Care Hospital Transfer: A Multicenter Study of Medicare ACO Beneficiaries

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Appendix Table 1. Characteristics of ACO Medicare Beneficiaries Transferred to LTACHs			
	Clinical Appropriateness of Transfer		
	Appropriate (n=33)	Inappropriate (n=72)	P-value
Sociodemographics			
Age, median years (IQR)	72 (63-79)	74 (61.5-78.5)	0.97
Race/ethnicity, n (%)			0.57
White	24 (72.7)	56 (77.8)	
Black	4 (12.1)	7 (9.7)	
Hispanic	3 (9.1)	8 (11.1)	
Other	2 (6.1)	1 (1.4)	
Female, n (%)	16 (48.5)	33 (45.8)	0.80
Lives alone, n (%)	7 (21.2)	19 (26.4)	0.57
Baseline Clinical Characteristics			
Dementia, n (%)	4 (12.1)	11 (15.3)	0.67
ADL impairment, n (%)	12 (36.4)	26 (36.1)	0.98
Receiving wound care, n (%)	5 (15.2)	27 (37.5)	0.02
Characteristics during Hospital Stay Preceding Transfer			
Admitted from home, n (%)	27 (81.8)	50 (69.4)	0.57
Length of stay, median days (IQR)	18 (12-24)	9 (6.5-13)	<0.001
ICU Stay, n (%)	27 (81.8)	32 (44.4)	<0.001
ICU stay ≥ 3 days, n (%)	26 (78.8)	21 (29.2)	<0.001
ICU length of stay, median days (IQR)	10 (6-20)	3.5 (2-6)	<0.001
DRG weight, median (IQR) [a]	4.9 (2.6-11.1)	2.0 (1.8-3.6)	<0.001
Diagnoses, Major Diagnostic Categories (MDC number) [a]			
Infectious (MDC 18)	10 (31.3)	16 (23.5)	0.41
Tracheostomy (MDC Pre)	10 (31.3)	7 (10.3)	0.009
Musculoskeletal (MDC 8)	3 (9.4)	12 (17.7)	0.28
Respiratory (MDC 4)	1 (3.1)	10 (14.7)	0.08
Mechanical ventilation, n (%)	20 (60.6)	10 (13.9)	<0.001
Prolonged Mechanical ventilation >96 hours, n (%)	18 (54.6)	6 (8.3)	<0.001
Tracheostomy operation, n (%)	10 (30.3)	3 (4.2)	<0.001
Wound debridement in operating room, n (%)	5 (15.2)	31 (43.1)	0.005

Abbreviations: ACO, accountable care organization; LTACH, long-term acute care hospital; ADL, activities of daily living; ICU, intensive care unit; DRG, diagnosis related group

[a] Missing information for 5 patients (1 appropriate and 4 inappropriate).

Appendix Table 2. Case Descriptions of Patients Inappropriately Transferred to an LTACH but Declined from SNF		
Reason for LTACH Transfer	**Reason Denied from SNF**	**Case Description**
Wound care	Too sick	70s year old hospitalized for debridement of an inguinal wound and transferred to an LTACH for negative pressure wound therapy requiring dressing changes three times per week. The patient was denied by SNF due to "acuity." The patient was ambulatory with a rolling walker, was hemodynamically stable on room air, had no intravenous medication needs, and the physical therapist recommended outpatient rehabilitation referral for the patient.
IV therapy	Financial	70s year old hospitalized for endocarditis and AKI on CKD, who was transferred for long-term intravenous antibiotics for 5 weeks with frequent monitoring for gentamycin toxicity. The patient was denied by the SNF because they were unable to afford the co-payment after 20 days.
Wound care IV Therapy	Financial	40s year old hospitalized for polymicrobial osteomyelitis of right transmetatarsal ampuated stump who was transferred for long-term intravenous antibiotics and simple wound care. The patient was denied by the SNF because they had insufficient Medicare days for SNF.
Respiratory Care	Too sick	80s year old hospitalized for complications of a motor vehicle accident, including severe traumatic brain injury, multiple fractures, and respiratory failure requiring mechanical ventilation via a tracheostomy. The patient was referred to a SNF soon after tracheostomy placement, which was denied due to complexity. However, the patient's condition improved. Their oxygen requirements were weaned to 2 liters/minute via tracheostomy collar, did not require oropharyngeal suctioning, wore a thoracolumbosacral brace for non-operative spine fractures, and received bolus nutrition via a percutaneous endoscopic gastrostomy (PEG) tube. The patient was not re-referred to a SNF later in the hospital stay.
IV Therapy	No skilled care needs	30s year old hospitalized for acute mediastinitis, and transferred for intravenous antibiotics (clindamycin and ceftriaxone) without any other care needs and was functionally independent at time of transfer. Patient was denied from the SNF due to "no skilled care needs". There was no documentation whether the patient was referred for home health care for home antibiotic infusions.
Respiratory Care	Too Sick	70s year old hospitalized for acute on chronic hypoxic respiratory failure from exacerbation of chronic bronchiectasis from influenza infection. The patient was never intubated nor required ICU care, and was cognitively and functionally intact. Patient was denied from the SNF due to too high oxygen requirements, but was steadily weaning down on the amount of oxygen and was on 5 liters/minute via nasal cannula at the time of LTACH transfer.
Abbreviations: LTACH, long-term acute care hospital; SNF, skilled nursing facility; IRF, inpatient rehabilitation facility; IV, intravenous; AKI, acute kidney injury; CKD, chronic kidney disease; ICU, intensive care unit		

Appendix Table 3. Appropriate LTACH transfers but did not meet payment criteria for full reimbursement ('false negatives')		
Reasons for Transfer	**ICU Days**	**Case Description**
Wound care	2	70s year old hospitalized for a malfunctioning peritoneal drain placed for management of a perforated diverticulitis, status post Hartman's procedure who was transferred for management of a midline abdominal wound requiring complex daily negative pressure wound therapy with water instillation and a IV opioid therapy via a patient controlled anesthesia pump
Wound care IV therapy	0	60s year old hospitalized for recurrent infection of a left hip arthroplasty, complicated by acute blood loss with hemorrhagic shock after surgical debridement. The patient was transferred to continue receiving complex incisional negative pressure wound therapy to be changed three times per week for two weeks, long-term intravenous antibiotics (vancomycin), and frequent monitoring of blood counts due to persistent slow hemorrhage from the wound site.
Wound care IV therapy	0	60s year old hospitalized for osteomyelitis and discitis of the spine and bilateral stage 4 decubitus ulcers of the hip complicated with abscesses, which developed during a preceding SNF stay. The patient underwent extensive debridement of the ulcers, which resulted in exposed boney structures, and was transferred for complex negative pressure wound therapy with water instillation therapy and high doses of intravenous opiate medication for dressing changes.
Wound care IV therapy	0	80s year old hospitalized for excisional debridement of recurrent left transmetarsal amputated stump osteomyelitis, and was transferred for complex wound care of stump with exposed bony structures, including negative pressure wound therapy changed three times per week with contact ultrasound treatment and intravenous antibiotics (vancomycin).
Cognitive impairment	0	90s year with advanced dementia hospitalized for recurrent pseudomonal heel osteomyelitis of a stage-3 ulcer who was transferred for long-term intravenous antibiotics (cefepime). The patient was approved for SNF transfer, but was not pursued since the patient's hospital course was complicated by delirium with agitation, with repeated removal of their intravenous catheter needed for antibiotic infusions
Respiratory care	0	70s year old hospitalized for acute hypoxic respiratory failure due to chemotherapy-related pneumonitis or fibrosis and was transferred for respiratory care given persistent hypoxia requiring high flow oxygen at 8L/minutes. The patient's hospital course was further complicated by delirium, with intermittent removal of the nasal cannula, as well as new functional impairment and urinary retention.
Wound care IV therapy Other (active GI bleed)	0	50s year old with end-stage renal disease (ESRD) and severe peripheral arterial disease status post femoral-popliteal bypass surgery and recent stent on aspirin and clopidogrel was hospitalized for symptomatic blood loss anemia due to gastrointestinal bleeding from a duodenal arteriovenous malformation requiring frequent blood transfusions and blood count monitoring for persistent slow GI bleed. The patient had multiple active co-existing conditions, including surgical site wound infection of a recent toe amputation requiring negative pressure wound therapy and intravenous antibiotics (cefepime), and hemodialysis.
Abbreviations: LTACH, long-term acute care hospital; IV, intravenous; SNF, skilled nursing facility; GI, gastrointestinal		

Appendix Table 4: Appropriate LTACH transfers that met current payment criteria but would not if adopted a minimum 8-day ICU length of stay criterion ('additional false negatives')		
Reasons for Transfer	**ICU Days**	**Case Description**
Wound care; Rehabilitation; Cognition	7	50s year old hospitalized for atrial flutter with rapid ventricular response and heart failure exacerbation complicated by ischemic hepatitis with encephalopathy briefly requiring intubation for airway protection, and ischemic colitis complicated by perforation status post emergent colostomy and ileostomy. The patient was transferred for rehabilitation, negative pressure wound therapy of abdominal surgical wounds (changed thrice weekly), monitoring of improving delirium (awake and followed commands at transfer), and daily ostomy monitoring and management.
Other (frequent oropharyngeal suctioning)	4	70s year old with recent L3-L5 laminectomy and spinal fusion complicated by dura cerebrospinal fluid leak was hospitalized for meningitis requiring irrigation and debridement, L5 decompression and dura repair. The hospital course was complicated by a massive posterior cerebrovascular accident. The patient was transferred in a near vegetative state to complete intravenous antibiotics (ampicillin) and required total assistance, including enteral nutrition via a percutaneous endoscopic gastrostomy (PEG) tube, indwelling urinary catheter, and 24/7 monitoring for frequent suctioning of oropharyngeal secretions.
Respiratory care	4	80s year old with advanced emphysema on home oxygen (4 L/min) and severe obstructive sleep apnea on nocturnal bilevel ventilation was hospitalized for acute on chronic hypoxic respiratory failure due to recurrent pleural effusion who received transient mechanical ventilation, thoracentesis, and a pleurodesis. The patient was extubated but still required high-flow oxygen (9L/min) and transferred for respiratory care, as well as intravenous diuretic administration for pulmonary edema and volume overload.
Wound care; Rehabilitation; IV therapy	6	70s year old who was extremely debilitated and bedbound for months was hospitalized for sepsis and cholangitis, status post cholecystostomy tube for drainage, and found to have multiple nonstageable decubitus ulcers, status post indwelling urinary and rectal catheters to divert incontinence from the wound beds. The patient was transferred to complete intravenous antibiotics (ceftriaxone), monitoring of cholecystostomy tube, and total 24/7 care, including maximal assist for transfers, and enteral nutrition via a temporary feeding tube.
Respiratory care	4	80s year old with history of an ischemic stroke and advanced vascular dementia hospitalized for acute hypoxic respiratory failure due to obstruction of a chronic tracheostomy by secretions who was transferred for intensive nursing and respiratory therapist care, which included frequent suctioning of the tracheostomy.
IV therapy	5	80s year old hospitalized for a perforated colon after a colonoscopy, complicated by peritonitis, status post emergency exploratory laparotomy, surgical repair with Hartmann pouch and colostomy, which was further complicated by a polymicrobial intraabdominal abscess status post percutaneous drainage. Prior to discharge, total parental nutrition and intraabdominal catheters were discontinued, delirium resolved, and strength was improving. The patient was transferred for multiple daily intravenous antimicrobial infusions (micafungin and piperacillin/tazobactim), and need for daily laboratory to monitor for adverse effects of medications.

Appendix Table 5. Inappropriate LTACH transfers despite meeting the proposed payment criteria applying a minimum 8-day ICU criterion	
Reasons for Transfer	**Case Description**
Cognition; Rehabilitation	70s year old hospitalized for hemorrhagic stroke status post craniotomy complicated by weakness, confusion, aphasia, and dysphagia, who was transferred for custodial care and rehabilitation. At transfer, the patient had intermittent confusion (improving delirium versus new-onset vascular dementia), improved functional status (ambulatory with use of a rolling walker without need for assistance), and was receiving enteral nutrition via a percutaneous endoscopic gastrostomy tube.
Respiratory care	60s year old hospitalized for septic shock with multi-organ failure due to a pneumococcal empyema, status post decortication, who was transferred for pulmonary rehabilitation to wean off supplemental oxygen via nasal cannula at 4 L/min for acute hypoxic respiratory failure. The patient was prescribed nocturnal bilevel ventilation for respiratory support, but was minimally using prior to transfer. The patient was otherwise cognitively and functionally intact.
IV therapy; Rehabilitation	40s year old with history of end-stage renal disease (ESRD) on hemodialysis was hospitalized for a vascular graft infection, with the hospital course complicated by an unexplained cardiac arrest with timely return of spontaneous circulation and three days of mechanical ventilation. The patient was extubated to room air cognitively intact. The patient was transferred for intravenous antibiotic infusion (ceftriaxone) via a femoral dialysis catheter, scheduled hemodialysis, and rehabilitation for improving functional impairment (wheelchair dependent requiring 2-person maximal assistance for transfers).
Respiratory care	80s year old hospitalized for complications of a motor vehicle accident, including severe traumatic brain injury, multiple fractures, and respiratory failure requiring mechanical ventilation via a tracheostomy. The patient was referred to a SNF soon after tracheostomy placement, and was denied due to complexity. The patient's condition improved. Their oxygen requirements decreased to 2 liters/minute via tracheostomy collar, did not require oropharyngeal suctioning, wore a thoracolumbosacral brace for non-operative spine fractures, and received bolus nutrition via a percutaneous endoscopic gastrostomy (PEG) tube. The patient was not re-referred to a SNF later in their hospital course.
Respiratory care	70s year old hospitalized at a small, rural hospital for chronic obstructive pulmonary disease (COPD) exacerbation due to influenza complicated by acute respiratory failure requiring mechanical ventilation and atrial fibrillation with rapid ventricular response treated with a diltiazem infusion, and transferred on hospital day 4 for "higher level of care". The patient was not evaluated by an intensivist and did not have a documented spontaneous breathing trial prior to transfer.
Physician preference; Other (debility, multimorbidity)	80s year old with history of left leg amputation was hospitalized for a pacemaker lead infection with bacteremia status post explantation and replacement, and infection of the amputated stump status post surgical revision. The hospital course was complicated by decompensated cirrhosis with hepatic encephalopathy, and decompensated heart failure. After a prolonged hospital course, the patient was "doing quite well," and transferred for intravenous antibiotic infusions (cefazolin), rehabilitation, simple wound care, and monitoring per the request of the consulting infectious disease physician. The patient was ambulatory with the use of a rolling walker, had intermittent mild confusion in setting of possible history of mild dementia, and was accompanied by an attentive partner who was at the bedside for the duration of hospitalization.