

# Hospital Readmission among Stroke Patients who Received Post-Hospital Care: A Systematic Review

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## Abstract

**Background:** Stroke is a leading cause of death and disability in both developed and developing nations. The need for posthospital care to promote continued recovery and prevent the onset of complications is high; however, the complexities of managing a stroke can result in readmissions to the hospital. This systemic review describes the rates, predictors and causes of readmission to the hospital among stroke patients who received short-term inpatient and community-based posthospital care.

**Methods:** Four databases were searched by the six authors to identify 102 unique citations meeting our search criteria published in English since 1997. Title and abstract screening, followed by full-text screening, was completed by pairs of authors and reconciled by a third author. Data were extracted and synthesized to answer our key questions related to hospital readmissions documented within 12 months of discharge.

**Results:** Eleven studies including 1 systematic review of randomized controlled trials, 6 retrospective and 4 prospective cohorts met our inclusion criteria. Readmission rates ranged from 8.2% to 74.5% likely due to the heterogeneity in study design, posthospital services examined, and timing of follow-up. Few models provided rates adjusted for case-mix, model discrimination or performance, or predictors of readmission by posthospital service (or a comparison of services), and none reported causes of hospital readmission by post-hospital service.

**Conclusions:** Available evidence suggests hospital readmissions from posthospital care are an important area for research and intervention to improve practice and guide health policy.

**Keywords:** Stroke; Readmission; Posthospital care; Systematic review

**Abbreviations:** HH: Home Health Agencies; SNF: Nursing Facilities; IRF: Inpatient Rehabilitation Hospitals or Units; CINAHL: Cumulative Index to Nursing And Allied Health Literature; MeSH: Medical Subject Heading; UDS<sub>MR</sub>: Uniform Data Set Medical Rehabilitation; ICD-9-CM: International Classification of Diseases, 9<sup>th</sup> Revision, Clinical Modification; UK: United Kingdom; US: United States; SD: standard deviation; NR: not reported; AIS: Acute Ischemic Stroke; TIA: Transient Ischemic Attack; VA: Veterans Affairs; DRG: Diagnosis Related Group; LOS: Length of Stay; FIM: Functional Independence Measure; CES-D: Center for Epidemiologic Studies-Depression Scale

## Introduction

Hospital readmission is being used as an indicator of several domains of healthcare quality including effectiveness, patient-centeredness, and efficiency [1]. Unplanned readmissions may, for example, indicate disruptions in care continuity when managing complex conditions or the quality of immediate posthospital care [2]. Posthospital care quality has not been as rigorously studied compared to other health services such as acute hospital or community-based primary care. Consequently, little is known about readmission rates, predictors or causes of readmission for patients who received posthospital rehabilitation care. This knowledge gap may be limiting opportunities for targeted interventions, focused measurement and improved care and outcomes.

Using the World Health Organization's measure of burden from disability, stroke is, and has been for decades, the leading cause of disability-adjusted life years lost (potential life lost due to premature death with years of productive life lost due to disability) [3]. The impending stroke epidemic from the baby boom generation is expected to increase direct (healthcare) and indirect (lost productivity) costs globally [4]. Yet the personal costs to the millions of stroke survivors,

77 million by 2030, are truly immeasurable [5]. Posthospital care is an essential health care component for returning stroke patients to their pre-event status. Outcome studies of stroke patients who receive rehabilitation therapy and services following hospital discharge consistently show strong evidence of the benefits of post-acute care [6,7]. The rate and risk of readmission to the hospital is, however, unclear.

The organization of and access to posthospital care varies widely across the globe. Utilization and patient outcomes are difficult in some countries to accurately measure [8]. For example, an analysis of Medicare beneficiaries in the United States found that stroke patients are the second most frequent users of posthospital care with 45% continuing therapy and care in inpatient settings of inpatient rehabilitation (IRF) or skilled nursing facilities (SNF), and 12% at home with home health (HH) [9]. Although these data are meaningful for health service planning and policy development, they only describe one subsample of patients. A reliable method for measuring use or tracking patient progress is not available for all patients with private insurance or who self-pay for care. Other developed and developing countries face similar issues of fragmentation in healthcare services and measurement with stroke patients experiencing more than two care transitions during a stroke episode [8]. Stroke patients may receive care in an acute hospital followed by rehabilitation in a different inpatient

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setting before discharge home with HH, community or outpatient services and follow-up in a clinic or by a primary care provider. Each handoff further increases the risk for discontinuous care and adverse events including rehospitalization [10].

Identifying the challenges in posthospital care that lead to hospital readmissions has important implications for influencing patient care, research and health policy. The purpose of this systematic review was to answer three key questions: (1) identify posthospital service-level readmission rates for stroke patients; (2) identify predictors of readmission from posthospital services including short-term inpatient services in an IRF or SNF, and community-based services in the home or outpatient setting; and, (3) identify causes for readmission from these settings.

## Methods

### Data sources and literature searches

The Cumulative Index to Nursing and Allied Health Literature (CINAHL), MEDLINE accessed through PubMed, the Cochrane Database of Systematic Reviews, and Web of Science Social Sciences Citation Index were comprehensively searched for peer-reviewed literature using a similar strategy for each database. Keyword nomenclature, developed with the National Library of Medicine's Medical Subject Heading (MeSH) terms for MEDLINE and revised to an appropriate variation thereof to adhere to database syntax, included (stroke) AND (rehospital\* OR readmission\* OR bounce-back) AND (rehabilitation OR "skilled nursing" OR "home health" OR "post-acute" OR "postacute" OR posthospital). The "\*" was used for truncation and the search in each database was limited to human cohorts and English language publications from January 1997 to March 2013. The date of first publication was selected to reflect the year Medicare prospective payment began for acute and post-acute care.

### Study selection

The study sample population included adult stroke patients with a diagnosis of ischemic or hemorrhagic stroke who had received acute care and were discharged to receive posthospital care services in inpatient, home or community-based settings. A comparator was not required for inclusion. The primary outcome was the unadjusted rate of hospital readmission from any posthospital service, at any time up to one year from the index hospitalization's discharge.

Qualitative studies, editorials, letters to the editor and case reports were excluded. Each title and abstract was independently examined by 2 reviewers for potential relevance. Articles included by any reviewer had full-text screening where 2 independent reviewers read each article to determine eligibility. A third-party arbitrator reconciled disagreements. Title, abstract and full text screening sought to identify studies of adult stroke patients, receipt of care or hospital discharge destination that included at least one posthospital service, and outcome data on hospital readmission.

### Data extraction, synthesis and study quality assessment

For each article the following data were extracted: author discipline, location, study aims/purpose, study design, stratification of discharge destinations or posthospital service use, duration of follow-up, clinical description of patient population, sample size, patient age, gender, race, source of data, unadjusted and adjusted (for case-mix, e.g., age or severity) findings by posthospital service, significant predictors of readmission, causes of readmission, and study limitations. Each study was examined for quality using a rapid appraisal checklist [11]. Studies

were summarized alphabetically due to the heterogeneity in study designs and posthospital services examined.

## Results

The initial search produced 115 citations and after removing duplicates resulted in 102 unique citations (Figure 1). Title and abstract screening as described removed 80 articles, and full text review removed an additional 11 articles that did not answer our first key question for this systematic review. Characteristics for the 11 included articles are described in table 1.

We identified 11 studies, including one systematic review of randomized controlled trials, [12] six retrospective studies analyzing Medicare claims, [13,14] a single site, [15] Veterans Health Administration, [16] and Uniform Data Set Medical Rehabilitation data (UDS<sub>MR</sub>), [17,18] and four prospective cohort studies including United States Veterans, [19] Medicare beneficiaries, [20] and patients from multiple sites [21,22]. Discharge to or receipt of posthospital care in 5 countries were reported with readmissions assessed at 1, 3, 6, or 12 months. Sample size ranged from 297 to 63,679 stroke patients, consisting of primarily older White adults (Table 2). Half of the studies used ICD-9-CM codes to define the stroke population.

Readmission rates were reported in table 3 separately for community-based and inpatient posthospital services. Unadjusted readmission rates for home-based care ranged from 21.0 - 47.0%. One study categorized home and inpatient rehabilitation care together and reported the readmission rate was only 8.2% [15]. Readmission to the hospital from IRF was 17.5 - 47.4% and from nursing facilities, SNF and institutional care ranged 15.0 - 74.5%. Few models provided adjusted rates, model discrimination or performance, or predictors of readmission by posthospital service (or a comparison of services). Predictors of rehospitalization from IRF care were reported in three studies and variables significant in at least two of the studies were

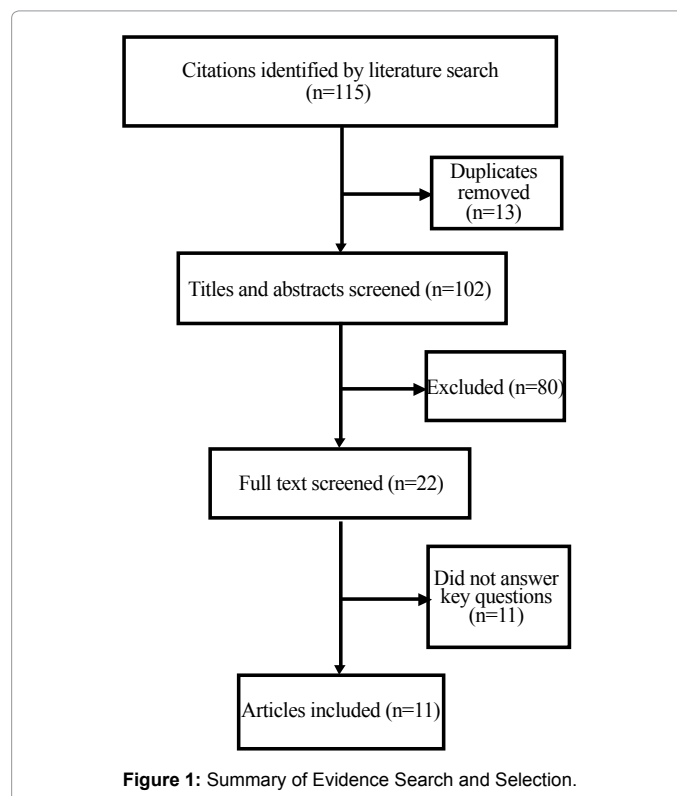


Figure 1: Summary of Evidence Search and Selection.

Reference	Publication Year	Study Location	Study Design	Duration of Follow-up	Posthospital Service(s) Examined
Anderson et al. [12]	2002	Multiple (UK, UK, Australia, Sweden)	Systematic review of randomized trials	3-12 months	Multidisciplinary home-based rehabilitation team (vs. standard care)
Berg and Intrator [13]	1999	US	Retrospective analysis of Medicare claims	12 months	IRF; SNF; home health
Berlowitz et al. [19]	2008	US	Prospective veteran cohort	6 months	IRF
Bhattacharya et al. [15]	2011	US	Retrospective single-site	1 month	Discharge to Home/IRF; SNF
Camberg et al. [16]	1997	US	Retrospective analysis of veteran data	1, 6 and 12 months	Veteran and community nursing homes
Chuang et al. [21]	2005	Taipei	Prospective multi-site cohort	1 month	Posthospital home or community-based care; "institutional" care
Kane et al. [20]	1998	US	Prospective Medicare cohort	12 months	HH, nursing home, IRF
Kind et al. [14]	2010	US	Retrospective analysis of Medicare claims	30 days	"bounce-back" from IRF, SNF, HH
Ottenbacher et al. [17]	2001	US	Retrospective analysis of UDS <sub>MR</sub>	80-180 days (3-6 months)	IRF
Ottenbacher et al. [18]	2001	US	Retrospective analysis of UDS <sub>MR</sub>	3-6 months	IRF
Ottenbacher et al. [22]	2012	US	Prospective cohort	3 months	IRF

**Table 1:** Characteristics of studies examining readmission of stroke patients who received posthospital care.

Reference	N	Stroke defined	Population Restrictions	Mean Age±SD years	Sex % Male	Race (Majority)
Anderson et al. [12]	297	NR for 4 eligible studies	Early hospital discharge intervention group	NR	NR	NR
Berg and Intrator [13]	4,551	ICD-9-CM codes of 430x, 431x, 432x, 434x or 436x	Age ≥ 70 years when hospitalized	79.2 ± 6.0	52.2%	86.7% White
Berlowitz et al. [19]	2,402	NR	Data in the Integrated Stroke Outcomes Database	67.7 ± 11.1	98.1%	NR
Bhattacharya et al. [15]	265	acute ischemic stroke (AIS) or TIA	Admitted to neurology dept of 1 hospital	AIS 61.9 ± 14.3 TIA 57.3 ± 15.6	50.9%	79.6% African American
Camberg et al. [16]	2,261	Stroke identified by ICD-9-CM codes (NR)	Age ≥ 65 years discharged alive from any VA hospital	NR	98.4%	81.5% White
Chuang [21]	489	ICD-9-CM codes 430-434, 436-438	Died, physically recovered, or incomplete data excluded (n=225)	73.2 ± 10.5	55.2%	68.7% Fukienese
Kane et al. [20]	487	Stroke DRG 14	Age 65+ years, Medicare, discharged alive from 51 hospitals	77.2	40.0%	85.6% White
Kind et al. [14]	63,679	ICD-9-CM 434 or 436 in 1 <sup>st</sup> position at hospital discharge	Age 65+ years, Medicare, discharged alive to IRF, SNF, or HH	79.0	38.3%	NR
Ottenbacher et al. [17]	15,992	Stroke	Discharged to IRF	71.0 ± 12.2	47.3%	80% White
Ottenbacher et al. [18]	9,584	Stroke	Discharged to IRF	70.7 ± 12.9	48.4%	77.6% White
Ottenbacher et al. [22]	674	ICD-9-CM 430-438	Age ≥ 50 years; Patients in Stroke Underserved Populations Recovery database	71.5 ± 10.5	48.8%	73.1% White

**Table 2:** Demographics of Stroke Patient Samples Studied.

ethnicity, length of stay, sphincter and self-care ability as measured by the Functional independence Measure [17,18,22]. None of the 11 studies in this systematic review reported causes of hospital readmission by posthospital service.

## Discussion

This systematic review identified 11 studies that reported rates of readmission from posthospital services or care settings, only 3 that examined predictors of readmission and no studies reported causes of readmission from any of the posthospital services examined. There was considerable variability in study design including type of data, timing of follow-up, and definitions of posthospital services provided as short-term inpatient, home or community-based care. Readmission rates ranged from 8-75% across the different posthospital services examined.

Although studies in this system review provided adjusted rates of readmission, only three examined and reported patient-level characteristics associated with hospital readmission [17,18,22]. All three of these studies examined IRF care, two in retrospective studies and one prospective cohort. The patient samples were similar in age, gender and race but the covariates differed from the prospective to retrospective studies, limiting the opportunity to draw conclusions about important predictors beyond a measure of motor function. This is an important area for future research in order to better identify stroke patients at higher risk for readmission and how these characteristics might differ for targeted interventions in different posthospital services.

A recent systematic review on predictors of hospital readmission that did not examine discharge to or receipt of posthospital care reported similar rates of readmission up to one year post-stroke,

Reference	Readmission from Community-based (Home or Outpatient) Posthospital Care	Readmission from Inpatient (IRF or SNF/ nursing home) Posthospital Care	Significant Predictors of Readmission
Anderson et al. [12]	Domiciliary: 22.9% (mean of 4 studies)	N/A	N/A
Berg and Intrator [13]	Home Health 45.5%	IRF 47.4% SNF 74.5%	NR
Berlowitz et al. [19]	N/A	IRF 27.6%	NR
Bhattacharya et al. [15]	Discharge Home/IRF 8.2%	SNF 23.8%	NR by posthospital service
Camberg et al. [16]	N/A	*SNF 1 month ~15-33%; 6 month ~ 42%; 12 month 54-57%	NR
Chuang et al. [21]	Home or community based care (full-time helper): 47.0%	Institution: 17.4%	NR
Kane et al. [20]	HH: Unadjusted 21% (Adjusted 20%)	SNF: Unadjusted 28%, Adjusted 22%; IRF Unadjusted NR, Adjusted >25%	NR
Kind et al. [14]	HH: Adjusted rate of 19-22% (varies by race/ethnicity)	IRF: Adjusted rate of 18-20% and SNF: 21-28% (varies by race/ethnicity)	NR
Ottenbacher et al. [17]	N/A	IRF: 17.5%	Gender, Ethnicity, LOS, FIM sphincter and self-care subscales, and FRG level
Ottenbacher et al. [18]	N/A	IRF: 18.3%	Age, marital status, LOS, ethnicity, FIM sphincter and self-care
Ottenbacher et al. [22]	N/A	IRF: 18%	high depressive symptoms (CES-D ≥ 16) and lower Duke Social Support ratings (<55), lower motor and cognition functioning

\*Estimated readmission rates from figures

**Table 3:** Reported Rates and Predictors of Readmission.

ranging from 12% to 62.2% for all-cause readmissions [2]. It is more common in studies of patients who received acute stroke care than studies of stroke patients who received posthospital care to examine predictors of readmission. None of the studies in either review provided models for the purpose of comparing facility- or service-level readmission rates. This is a tremendous gap in the literature that is limiting the development of empirically-based policies related to quality measurement.

Reduction of avoidable readmissions is a high priority for the United States Department of Health and Human Services and quality reporting programs have been introduced for all posthospital care settings [23]. Although 30-day comprehensive all-cause risk-standardized readmissions have been proposed as a quality measure for posthospital settings, this systematic review confirms that little is known about facility-level readmission rates, or predictors or causes of readmission for patients who received posthospital rehabilitation care.

Additional research is needed into the predictors and causes of hospital readmission from posthospital care in order to target intervention and quality improvement efforts in these settings. The length of an acute hospitalization is substantially shorter—on average only four days in the United States—in comparison to the number of days of care provided by posthospital services [9,24]. The opportunity to reduce negative consequences experienced by patients and health systems can positively influence both short- and longer-term outcomes.

This comprehensive review of the peer-reviewed literature published over the last 15 years has several limitations. We only reviewed English language articles, possibly excluding studies of posthospital services, and we did not include gray literature such as agency reports, doctoral dissertations, or conference proceedings. In the few studies we did identify and review, we were able to conclude that stroke readmissions occur from each posthospital service or setting and recommend that rigorous research be conducted to determine the patient-level predictors and causes of hospital readmission. This

research could inform the development of interventions and quality improvement efforts and could contribute to the discussions occurring on posthospital facility-level quality measures. The lack of empirical knowledge regarding readmissions from posthospital services represents an important gap that needs to be addressed in order to appropriately address the significant burden on stroke patients and healthcare systems and build strategies for optimal outcomes.

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