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Reducing Hospitalizations From Long-Term Care Settings

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Hospital spending represents approximately one third of total national health spending, and the majority of hospital spending is by public payers. Elderly individuals with long-term care needs are at particular risk for hospitalization. While some hospitalizations are unavoidable, many are not, and there may be benefits to reducing hospitalizations in terms of health and cost. This article reviews the evidence from 55 peer-reviewed articles on interventions that potentially reduce hospitalizations from formal long-term care settings. The interventions showing the strongest potential are those that increase skilled staffing, especially through physician assistants and nurse practitioners; improve the hospital-to-home transition; substitute home health care for selected hospital admissions; and align reimbursement policies such that providers do not have a financial incentive to hospitalize. Much of the evidence is weak and could benefit from improved research design and methodology.

Keywords: *hospitalization; long-term care; intervention; nursing home; home health care*

While only a small fraction of people are hospitalized in any given year, hospital spending represents approximately one third of total national health care spending, and the majority of hospital spending is by public payers (Smith et al. 2005). Elderly individuals with long-term care (LTC) needs are at particular risk for hospitalization; for example, more than 25% of long-stay nursing home residents are hospitalized in any given 6-month period (Intrator, Castle, and Mor 1999). These statistics are not likely to improve anytime soon. Well-known demographic trends point to an increasing need for health care services in coming decades, especially among elderly individuals with LTC needs (Knickman and Snell 2002). As health care costs continue to increase and as we focus more attention on the best approaches to chronic care, reducing the rate of hospitalizations from LTC becomes an important priority. For example, the Centers for Medicare and Medicaid Services (CMS) is sponsoring

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a national campaign to encourage home health agencies to focus efforts on reducing avoidable hospitalizations (CMS 2007). In this article, we review the evidence on LTC interventions that reduce hospitalizations among elderly LTC recipients.

Reducing hospitalizations from LTC settings is likely to have implications for health as well as health care costs to society. A default policy to transfer when clinical indications are unclear is unlikely to be optimal, because the stress of transfer and the risk of nosocomial infection are not trivial for frail LTC recipients and can outweigh the health benefits from treatment in the hospital. For example, a number of studies suggest that many hospitalizations for pneumonia could and should be avoided, as outcomes among those hospitalized can be worse than among those with similar illness severity who are treated without transfer (Fried, Gillick, and Lipsitz 1995, 1997; Saliba et al. 2000; Thompson et al. 1997; Thompson, Hall, and Szpiech 1999). Furthermore, while financial incentives to particular providers may vary, the cost to society of inpatient treatment is almost always more expensive than treatment in other settings. Reducing discretionary and avoidable hospitalizations from LTC settings therefore has the compelling potential to improve health outcomes while simultaneously reducing overall costs for an increasingly important segment of the population.

While reasons for hospitalization among elderly LTC recipients are widely distributed among diagnoses, some aggregated categories provide compelling evidence that even specialized interventions could have a large impact on overall hospitalization rates: More than a quarter of all hospitalizations among nursing home residents are due to infections, and 17% are due to circulatory system disease, including heart failure (Murtaugh and Freiman 1995). Not surprisingly, many interventions designed to reduce hospitalizations target these conditions, but some components of these interventions have potentially wider applicability across diagnoses.

New Contribution

While there is increasing evidence and agreement that hospitalizations from LTC settings should be reduced, there appears to be only fragmented evidence on the best mechanisms for reducing them. Evidence on particular interventions appears in medical, nursing, sociology, economics, and health services research publications, and interested providers and policymakers may not access this range of sources. The health services research studies tend to draw on large administrative databases to study individual and organizational determinants of hospitalization, while the clinical literature often focuses on disease-specific interventions. Even within a category of journals, most studies are setting-specific, while many readers are involved in several types of care (e.g., nursing facility care and home health care). This is the first article to synthesize and summarize the evidence from these disparate sources on LTC interventions that work (and do not work) to reduce hospitalizations among

elderly LTC recipients across institutional and home-based settings. We focus specifically on interventions, as opposed to patient-level risk factors, to maximize relevance for policy and practice.

Conceptual Framework

We view LTC populations as distinct from settings of care. People with LTC needs generally have chronic conditions and associated functional and/or cognitive limitations that require assistance with activities of daily living (e.g., bathing, dressing, toileting, transferring, eating) or instrumental activities of daily living (e.g., housekeeping, using a telephone, preparing meals, money management). These types of needs can be served in a variety of settings. LTC can be provided in the home (formally or informally), in a nursing home, in an assisted living facility, or in an adult day care center, among others. Settings of care do not necessarily represent levels of care, and it is often financing—not level or type of need—that determines the setting of care. Increasingly, experts in aging and LTC call for policies and practice to look beyond settings of care and to look at LTC recipients and their needs and preferences more generally (Kane, Kane, and Ladd 1998; Stone 2000).

While the need for assistance with functional or cognitive limitations is the defining feature of a LTC population, they are also in need, like most people, of primary care and intermittent acute care. Furthermore, the lines between acute care, postacute care, and LTC have become blurred for LTC recipients, as more and more high-tech services formerly provided only in hospitals are now considered part of LTC and administered in a variety of settings (Stone 2000). Because LTC needs affect daily life, the way that LTC needs are met (or not met) often affects how primary care and acute care needs are addressed, which in turn affects subsequent LTC. For example, insufficient home health care may lead to more frequent hospitalizations and subsequent nursing home placement. On the other hand, insufficient primary care or postacute care in some nursing homes may lead to more frequent hospitalizations and a lower probability of discharge to home; many long-stay nursing home residents start out as postacute patients. Across these LTC settings, many hospitalizations can be thought of as failures in meeting more basic types of care, and interventions that aim to reduce hospitalizations are likely to have commonalities across settings. In this article, therefore, we assess LTC interventions with potential to reduce hospitalizations among the elderly regardless of original setting.

Hospitalizations can be loosely classified into those that are avoidable versus unavoidable (Carter 2003a; Intrator, Zinn, and Mor 2004). Some hospitalizations may be seen as avoidable because the underlying event or exacerbation is avoidable with proper care of a chronic condition. For example, hospitalizations related to diabetes, congestive heart failure (CHF), and chronic obstructive pulmonary disease (COPD) can be considered avoidable if proper diet, exercise, and medication man-

agement are maintained. A separate but related distinction can be made between hospitalizations that are discretionary versus nondiscretionary once an adverse health event has occurred (Carter 2003b). While hospitalization is seen as always necessary for some acute conditions such as hip fracture and second stroke, transfer to a hospital is often discretionary for other conditions such as pneumonia and influenza. In the discretionary cases, the decision to hospitalize may depend on resources available in the LTC setting and facility and family preferences as well as clinical status of the individual (Konetzka, Spector, and Shaffer 2004). The potential for reducing hospitalizations is clearly greatest among avoidable and/or discretionary cases.

Methods

We searched for all peer-reviewed articles published between 1990 and 2005 that empirically assess the determinants of inpatient admissions from LTC settings or test the effectiveness of particular interventions in reducing hospital admission and readmission rates, length of stay, emergency room visits, or hospital costs among elderly LTC recipients. Experimental and quasi-experimental (observational) studies were included if they had a minimum sample size of 20 individuals and attempted to control for confounding and selection bias using at least one of the following: (a) randomization to treatment and control groups, (b) inclusion of a nonrandom control group with multivariate adjustment or matching for differences in risk, and (c) inclusion of a nonrandom control group with pre/postmeasurements on both groups to account for secular trends (change or "difference in differences" model). While randomized, controlled trials (RCTs) arguably provide the strongest evidence for causality because randomization can eliminate measured and unmeasured confounders, they are often conducted with homogenous patient groups and under restricted conditions to maintain adequate control. Therefore, generalizability of results can be problematic. In addition, in some cases RCTs are not feasible for practical or ethical reasons. Observational studies, on the other hand, generally employ larger and more representative samples but are subject to selection bias and other types of confounding, the potential for which can be minimized but not eliminated through strong quasi-experimental designs and multivariate controls. We include both types of studies to consider the breadth and strength of the evidence.

We limited studies to include those conducted in formal settings only—for example, nursing homes, assisted living facilities, and home health care—and we included studies of elderly recipients of postacute care when administered in these settings for reasons described in our conceptual framework. Because our intent was to focus on the population 65 years of age and older, we excluded studies that focused primarily on the adult disabled or children. While that distinction was obvious for the vast majority of studies, we applied a rule for borderline cases that the mean age in the study population had to be at least 65. For the included populations,

studies of interventions that aim to reduce adverse events leading to a hospitalization were included as well as interventions that are directed at the transfer decision once an adverse event has occurred, as long as hospitalization was considered explicitly as an outcome. We did not include evaluations of disease management programs without a specific LTC component, as participants of disease management programs alone are not necessarily LTC recipients.

Because the intent of this review is to provide useful information for policymakers and practitioners, we excluded studies where the intervention was not explicit. For example, studies comparing hospitalization rates in urban versus rural settings or in for-profit versus nonprofit facilities, while suggestive, led to no clear action that could be taken. Inclusion or exclusion of any questionable intervention in this regard was resolved by consensus among the authors.

The initial search was conducted using combinations of the following keywords in the PubMED and Web of Science databases: hospitalization, hospital admission, readmission, nursing homes, nursing facilities, assisted living, home health, home care, LTC, boarding home, residential care, subacute care, postacute care, ER admission, and emergency room. Approximately 950 articles were initially identified for potential inclusion. A review of abstracts for key criteria—study of an LTC population (elderly individuals in institutions or in home care or who need assistance with activities of daily living), LTC intervention, and explicit use of hospitalization as an outcome—left us with approximately 130 potential articles. The full texts were then collected and examined carefully for appropriate inclusion in the analysis and for additional search terms and references, which were subsequently retrieved and examined. Our final sample contained 55 articles. Note that while we discuss the magnitudes of effects found, this is not intended to be a meta-analysis and no attempt was made to standardize findings across studies.

Results

The vast majority of studies that met our inclusion criteria were nursing home (18) or home health care (34) studies, with the remaining assisted living (1) or home- and community-based care (2) studies. While our minimum sample size for inclusion was 20 patients or residents, most studies had substantially larger samples: several hundred for experimental studies and generally thousands for observational studies. All but a few were positive studies in the sense that some statistically significant decrease in hospitalization was found. RCTs (29 articles) comprised the most common study design, followed by observational studies (23 articles). However, the distribution of type of study designs was highly skewed based on the type of intervention studied, as noted throughout the Results section of this review.

Because we were interested in attributes of interventions that seem to work independently of setting, we classified studies into six main substantive categories across

LTC settings by the intervention strategy. These categories are for convenience of exposition in describing our results; we draw parallels across categories in the discussion section. The categories are:

- increase staffing,
- improve care management at transitions from hospital to home or from hospital to skilled nursing facility,
- substitute home health care for hospital days,
- prevent high-risk clinical problems,
- change system of care to improve quality, and
- affect provider incentives through changes in policy.

Table 1 lists the studies falling into each of these categories, examples of interventions, and the distribution of study designs for each category.

Staffing

A logical connection exists between the intensity of care an individual receives and the outcomes of that care, at least in theory. Increasing staffing ratios has received much attention in recent years as a mechanism for improving quality across health care settings. However, only a small subset of staffing studies examines the effects of these interventions on hospitalization rates from LTC settings. We found nine studies that examine the effects of increasing service intensity or primary care by increasing the number of staff at various skill levels. The vast majority are observational, nonrandomized studies employing only cross-sectional analysis, but show largely consistent promise for staffing and primary care interventions.

Several studies evaluate the use of nurse practitioners and/or physician assistants to increase service intensity. Nurse practitioners and physician assistants are hypothesized to be a cost-effective alternative because they offer more skilled care than RNs but cost less than physicians. Kane and colleagues evaluate the Evercare program, a capitation model for Medicare services that employs a cadre of nurse practitioners to provide intensive primary care and monitoring to long-stay nursing home residents (Kane et al. 2003). The capitation system is a form of Medicare risk contracting such that Medicare pays an insurer a set rate to take on responsibility for all health care costs for a nursing home resident, including hospitalization costs. The goal is to increase the incentive to provide preventive care and decrease the incentive to use acute-care services such as hospitalization. The study compares Evercare enrollees in five sites to two sets of controls, residents in the same nursing homes who did not enroll and residents of non-Evercare nursing homes, and finds that Evercare enrollees had a hospitalization rate half that of either control group after 2 years. Use of each nurse practitioner is estimated to save $103,000 a year in hospital costs. Another study compares the approaches of three different health maintenance organizations (HMOs), all of which used physician assistants and nurse

Table 1
Reducing Hospitalizations From Long-Term Care Settings: Articles Reviewed

Type of Intervention	Article	Study Design
Increase staffing (nurse practitioners and physician assistants, nurses, physicians)	Carter 2003a, 2003b; Ganz, Simmons, and Schnelle 2005; Intrator and Mor 2004; Intrator, Castle, and Mor 1999; Kane et al. 2003; Rector et al. 2005; Reuben et al. 1999; Zimmerman et al. 2005	observational (8), cost/effect analysis (1)
Improve care management at transitions (hospital to home, hospital to nursing facility)	Cleland et al. 2005; Crotty et al. 2004; Farrero et al. 2001; Feldman et al. 2004; Harrison et al. 2002; Huddleston and Kobb 2004; Intrator and Berg 1998; Jerant, Azari, and Nesbitt 2001; Kobb et al. 2003; Lee et al. 2002; Li, Morrow-Howell, and Proctor 2004; Naylor and McCauley 1999; Naylor et al. 1999, 2004; Poole et al. 2001; Rich et al. 1993, 1995; Stewart and Horowitz 2002; Stewart, Pearson, and Horowitz 1998; Stewart et al. 1998; Thompson, Roebuck, and Stewart 2005	randomized, controlled trial (16); nonrandomized trial (1); observational (4)
Substitute home health care for hospital days (home health care in place of inpatient admission, reduced inpatient length of stay with postdischarge home health care)	Cotton et al. 2000; Davies et al. 2000; Fabris et al. 2004; Hernandez et al. 2003; Nicholson et al. 2001; Ojoo et al. 2002; Ricauda et al. 2004; Shepperd et al. 1998; Skwarska et al. 2000; Stessman et al. 1996; Tibaldi et al. 2004	randomized, controlled trial (10); nonrandomized trial (1)
Prevent high-risk clinical problems (pharmaceuticals, equipment, clinical processes)	Boxall et al. 2005; Eaton et al. 2002; Johnson, Dooley, and Gleick 1993; Naughton et al. 2001; Ochs et al. 2005; Schwien, Gilbert, and Lang 2005	randomized, controlled trial (2); observational (4)
Change system of care to improve quality (assessment, data-based quality improvement, end-of-life care)	Landi et al. 2001; Miller, Gozalo, and Mor 2001; Mor et al. 1997; Shaughnessy et al. 2002	randomized, controlled trial (1); observational (3)
Affect provider incentives through changes in policy (increase Medicaid rate, risk contracting)	Intrator and Mor 2004; Kane et al. 2004; Konetzka, Spector, and Shaffer 2004; Wieland et al. 2000	observational (4)

practitioners to provide primary care to long-stay nursing home residents, to the care received by non-HMO residents in the same homes (Reuben et al. 1999). The authors find that the HMO that provided the most primary care visits per month (2 visits vs. 1.1 for non-HMO) was associated with significantly fewer emergency room visits and hospital admissions, but that no similar benefit emerged for the other HMOs' primary care efforts. Two observational studies using large data sets provided additional evidence that the use of nurse practitioners and physician assistants is associated with lower hospitalization rates (Intrator, Castle, and Mor 1999; Intrator, Zinn, and Mor 2004).

One commonly suggested intervention strategy in recent years is to increase nurse staffing in nursing homes. One observational study conducted with data from assisted living facilities found that those with more registered nurse (RN) care hours had lower hospitalization rates (Zimmerman et al. 2005), while Rector and colleagues found a similar RN effect among Evercare enrollees in nursing homes (Rector et al. 2005). Consistent with the importance of RN staffing, two studies conducted using Massachusetts Medicare claims found that nursing homes with higher expense ratios of RNs to licensed practical nurses (LPNs) had lower hospitalization rates (Carter 2003a, 2003b). The cost implications of increasing RN staffing are unclear and perhaps less sanguine. A cost-effectiveness analysis of increasing staffing levels from the median to the levels recommended by the CMS found that the hypothetical increase would be cost-effective to Medicare in terms of reduced hospitalizations for those facilities with the highest baseline hospitalization rates, but not on average for all facilities (Ganz, Simmons, and Schnelle 2005). Other benefits from increased staffing, however, were not considered.

Very little evidence exists on the role of physicians in LTC and the potential for increased physician hours to affect hospitalization rates. The two studies we found, both observational studies using large data sets, provided mixed evidence: one found that the number of physician hours was associated with fewer hospital admissions (Intrator, Castle, and Mor 1999) and the other found that facilities with more physicians had more ambulatory-care-sensitive admissions (Intrator, Zinn, and Mor 2004). Because these were associations and not causal models, it is difficult to reconcile the discrepancy in results and draw conclusions as to the potential effect of increasing physician hours on hospitalization rates.

Viewed as a whole, the evidence on the potential for changes in staffing is promising but weak. Studies that examined the use of nurse practitioners and physician assistants to provide more primary care in institutional settings consistently found the intervention to reduce hospitalization rates and to be cost-effective. Higher RN staffing was consistently found to be associated with reduced hospitalization rates, but estimated magnitudes of effect vary widely and cost-effectiveness is unclear. While these interventions make theoretical sense and clearly have the potential for significant reductions in hospital admissions and costs, the evidence is based largely on cross-sectional, nonrandomized studies that inherently cannot adjust adequately

for confounding. In particular, it is impossible to assess what magnitude of change in hospitalization rates would result from a change in staffing in a cross-sectional study. Not surprisingly, the magnitudes presented in these studies vary widely. Future research should employ longitudinal and/or randomized designs to confirm the benefit and to more accurately assess the magnitude of the potential benefit from increasing staffing in LTC settings.

Transitions

Transitions from one health care setting to another have long been recognized as risky in terms of the potential for information loss and discontinuities in care processes. Interventions that aim to improve transitions from the hospital to LTC tend to focus on improving communication among providers and improving education of patients on self-care to reduce the likelihood of readmission to the hospital. We found 21 studies addressing two main types of interventions: those meant to improve the transition from hospital to skilled nursing facility and those meant to improve the transition from hospital to home.

A large body of work addresses the hospital-to-home transition, either by evaluating the effectiveness of postacute home health care itself in reducing readmissions or the effectiveness of improved coordination between hospital providers, home health care providers, and patients and their families. The interventions that aim to improve hospital-to-home transitions are almost entirely disease-specific. The vast majority pertain to CHF because of its prevalence in the population and because hospitalization and rehospitalization is a frequent occurrence among those who suffer from CHF. Post-acute CHF interventions are multifaceted and generally entail predischarge counseling and education, a medication review, and one or more nurse home health visits postdischarge. Six of the CHF papers evaluating home health as a postdischarge intervention describe RCTs, and these all conclude that readmission rates were lower in the intervention group (Naylor et al. 2004; Rich et al. 1993, 1995; Stewart and Horowitz 2002; Stewart et al. 1999; Thompson, Roebuck, and Stewart 2005), while one observational study finds no significant effects of a home health intervention on CHF readmissions (Li, Morrow-Howell, and Proctor 2004). Two randomized trials were conducted on other types of medical/surgical patients and similar results were found (Naylor and McCauley 1999; Naylor et al. 1999; Stewart et al. 1998). Estimates of the magnitude of effect of postdischarge home health care are generally dramatic, ranging from a 22% reduction in readmissions after 6 months to a 62% reduction after 8 weeks. Several of these studies also found that total costs of care were lower in the intervention group. Finally, one observational study was conducted on the effectiveness of home health care after inpatient rehabilitation for hip fracture, with similar but weaker results in terms of reduced readmissions (Intrator and Berg 1998). As a whole these studies suggest that the use of home health for postacute care can be a cost-effective intervention to reduce readmissions for chronic conditions, but the effect has been

studied in a limited set of conditions and populations.

An alternative to home visit is the use of a remote health monitoring device that allows health monitoring without an in-home visit. Two randomized control studies compared the use of the device with usual care or phone monitoring and found that phone monitoring or use of the device resulted in fewer hospital days than usual care. No differences were found between phone monitoring and use of the device (Cleland et al. 2005; Jerant, Azari, and Nesbitt 2001). Two other studies conducted in Veterans Administration (VA) settings among patients with a variety of chronic care needs comparing a monitoring device to usual care found that patients receiving the monitoring device had fewer hospitalization days (Huddleston and Kobb 2004; Kobb et al. 2003). The use of a monitoring device at home or phone monitoring appear to be more effective in reducing hospitalization than usual care; however, it remains unclear whether these are as effective as interventions that include actual home visits, and no evidence exists on the cost-effectiveness of these technologies.

The studies described in the paragraph above compare home health for postacute care with the absence of home health, often in conjunction with a patient education program and medication review. A slightly different type of intervention aims to improve the transition to home health by improving nurse skills or communication as part of a multifaceted intervention compared with the standard transition. The standard transition is often characterized by inadequate coordination between clinicians in the two settings and incomplete sharing of health data, resulting in medication errors and discontinuities in care (Coleman 2003; Parry et al. 2003). One intervention (Harrison et al. 2002) included enhanced communication between hospital nurses and home health nurses along with patient education and other components. Harrison and colleagues tested this type of intervention with an RCT among patients with CHF and found evidence that the intervention significantly reduced emergency room visits by approximately 37% (Harrison et al. 2002). Another multifaceted intervention that included specialized nurse training to improve nurses' patient teaching and support skills was found to reduce readmission rates among patients with CHF who entered the program after discharge from the hospital compared to normal transitional care (Feldman et al. 2004).

A similar type of intervention involves enhancing home health care services for COPD patients who have frequent hospital admissions and readmissions. These studies find that home-based management of COPD leads to lower hospitalization rates and decreased length of stay, although the intensity of these interventions varies. One study used skilled respiratory nurses and physicians to conduct quarterly home visits, monthly telephone follow-up, and facilitated access to hospital resources without inpatient admission for patients requiring long-term oxygen therapy (Farrero et al. 2001); the other used clinical nurse specialists and social workers in a case management role to conduct home visits, educate patients, and monitor health for patients with recurrent hospital admissions (Poole et al. 2001) Both were RCTs, thus supporting consistency of the evidence with strong study designs. It remains unclear,

given that the interventions have focused on specific clinical population and are multifaceted, whether the benefits of enhancing home health care through increased nurse training and patient education is effective across conditions, and which components are the essential ones.

Only two studies, both conducted outside the United States, examined interventions designed to improve the transition from hospital to skilled nursing facility, and evidence from them is mixed. Both interventions involved the use of nurses or pharmacists from outside the nursing home acting as liaisons and providing additional monitoring and coordination of care. An RCT conducted in Australia found that the use of a pharmacist transition coordinator to enhance medication management reduces the odds of readmission by as much as 62%, conditional on survival (Crotty et al. 2004). In contrast, an intervention based in Hong Kong that provided visits, assessment, and monitoring by community nurses in conjunction with nursing home staff had no apparent effect on hospital readmissions for COPD (Lee et al. 2002).

In summary, the strongest evidence on interventions that aim to improve transitions from the hospital pertains to the hospital-to-home transition for chronic care patients. While efforts to improve the transition from hospital to skilled nursing facility may be beneficial, the evidence base is very weak and requires more research. The evidence on the effectiveness of home health care in preventing or delaying readmissions is much stronger in the number and quality of studies, though they have been conducted largely among CHF patients. This latter category could benefit from research on the cost-effectiveness of the interventions.

Substituting Home Health Care for Hospital Days

One relatively recent type of intervention aimed at reducing hospitalization or shortening the length of stay in the hospital is home hospitalization, the provision of nursing and physician services through home visits in lieu of admission to a hospital or coupled with earlier hospital discharge. These programs primarily target individuals with chronic care needs and frequent admission to the hospital. The interventions range from predischarge education with follow-up nurse home phone calls for those discharged early to a more intensive intervention including home visits by nurses, physicians, and physical therapists when substituting for hospital admission altogether. For these studies, the question is whether patients receiving the increased home care but less hospital care have equivalent outcomes and rehospitalization rates.

Eleven studies of home hospitalizations were reviewed. These were all conducted outside of the United States but generally had positive findings. Seven studies focusing on COPD patients were recently reviewed by Ram and colleagues (Ram et al. 2004). These studies (Cotton et al. 2000; Davies et al. 2000; Hernandez et al. 2003; Nicholson et al. 2001; Ojoo et al. 2002; Shepperd et al. 1998; Skwarska et al. 2000) showed that for COPD patients, receiving home care in lieu of hospital care is generally safe, but also found significantly lower readmission and mortality rates. Four

of the seven studies included cost analyses and found the home hospitalization model to be cheaper than the hospitalization approach, but the authors of the review concluded that the quality of the cost analyses were too inconsistent to provide definite conclusions. The four remaining non-COPD home hospitalization studies focused on stroke patients (Ricauda et al. 2004), general patient population (Stessman et al. 1996), and patients with dementia (Fabris et al. 2004; Tibaldi et al. 2004). These studies found no negative and sometimes beneficial effects of home hospitalization on mortality, readmission, or other outcomes.

Of the home hospitalization studies, 10 of the 11were RCTs. The exception (Stessman et al. 1996) was the only non-COPD study to include a cost analysis. It found that total costs were lower among the home health group. While the relative prevalence of RCTs among studies of home hospitalization and the consistency of the positive conclusions are encouraging, some caveats remain. The ages of participants in these studies were at the low end of our inclusion criteria, that is, the mean age was generally 65 to 70 as opposed to the older groups involved in other types of interventions. The extent to which the intervention could be applied to older LTC recipients, other conditions, and other ranges of severity is still unclear, as is the cost-effectiveness. It is interesting that none of these studies was conducted in the United States, raising the question of applicability of the results to the U.S. health care system. However, pilot studies have been conducted in the United States as well, with results similar to those discussed here (Leff et al. 1999). These studies did not meet our inclusion criteria due to sample size or lack of a control group, but their existence suggests that there is no particular reason the intervention could not be implemented and studied in the United States. Overall, the home hospital intervention seems promising. Because the cost analyses that have been done generally find cost savings with home hospitalization, the intervention has the potential to improve outcomes and reduce costs simultaneously if the target populations can be more clearly defined.

Prevention of High-Risk Clinical Problems

Another approach to preventing hospitalizations for elderly LTC recipients is the use of clinical interventions aimed at preventing medical conditions that are likely to lead to hospital admission, for example, medical conditions such as pneumonia, complications from CHF, and late-stage pressure ulcers. Our review found a variety of interventions but the findings are mixed.

A recent review of studies of influenza vaccination found their use to be effective in reducing hospitalizations from nursing homes (Jefferson et al. 2005); the particular articles addressing hospitalization from nursing homes leading to this conclusion, however, did not meet the inclusion criteria for our review. The implementation of guidelines for antibiotic use in treating nursing home–acquired pneumonia had no apparent effect on hospital admission rates (Naughton et al. 2001). Likewise, there was no effect on hospitalizations from the use of statins among residents with cardiovas-

cular problems (Eaton et al. 2002) or from the use of oral nutritional supplements (Johnson, Dooley, and Gleick 1993). One was an RCT and the others were observational or case-control studies. Using air-fluidized beds or static overlays and replacement mattresses compared with low-air-loss beds appears to reduce pressure ulcers and the resulting hospitalizations significantly (Ochs et al. 2005). An observational study using home health assessment data found that hospitalization rates were significantly lower among patients receiving negative pressure wound therapy for stage III or IV pressure ulcers, a process of applying subatmospheric pressure using a foam dressing and a connected computerized therapy unit to promote wound healing (Schwien, Gilbert, and Lang 2005). An RCT revealed no effect of a home-based pulmonary rehabilitation program on hospital readmissions for COPD patients but significantly decreased hospital length of stay (Boxall et al. 2005).

The positive studies described in this section with the potential to affect the largest number of people focus on treatment and prevention of pressure ulcers across settings. Further research on the cost-effectiveness of these approaches would be beneficial.

Systems of Care to Improve Quality

Several studies in the nursing home and home health settings evaluated standardized assessment tools and the use of assessment data to improve diagnosis and care. Mor and colleagues (1997) studied the introduction of the Resident Assessment Instrument (RAI) for nursing home residents, now federally mandated. The RAI is an intervention that increases documentation of resident health and functional status with triggers for treatment when health problems are identified. The authors studied 268 nursing homes before and after the RAI was introduced and found that the adjusted odds of hospitalization decreased significantly for cognitively impaired and cognitively intact residents, adjusting for the health and functional status of residents (Mor et al. 1997). While the results are potentially confounded by secular trends, they are consistent with results from a randomized study in the home health setting. The study, conducted in Italy, assessed the impact of a new assessment system for home health care recipients (Landi et al. 2001). The assessment instrument, called the Minimum Data Set for Home Care (MDS-HC), is a screening tool covering multiple domains including functional status, health status, social support, and service use for older home care clients. Like the MDS for nursing homes, the MDS-HC is designed to aid in care planning and incorporates triggers for care when specific health problems are identified. The group assessed with the MDS-HC had significantly lower hospital admission rates and total costs of care and were at home longer before the first admission compared with a conventional assessment group.

Given the interest in data-based quality improvement programs in recent years, we were surprised to find only one study addressing the effects on hospitalization rates of using assessment data for quality improvement in LTC. The study focused on agency use of quality indicators derived from the Outcome and Assessment

Information Set (OASIS), which are then used to compare patient outcomes over time and with other agencies to identify potential care problems (Shaughnessy et al. 2002). The data-based intervention, which was evaluated using a strong quasi-experimental difference-in-differences design, revealed significant reductions in hospitalization rates with use of the quality indicators.

Finally, one study addresses systems for end-of-life care. A study of hospice care in nursing homes found not only that hospitalization rates were lower among hospice residents compared to other residents, but that nursing homes with a substantial hospice presence were less likely to hospitalize even nonhospice residents (Miller, Gozalo, and Mor 2001). This study suggests that hospitalizations may be reduced through increased use of hospice in nursing homes. However, like the staffing studies, this study is based on a cross-sectional design. Nursing homes with facility cultures that are more amenable to palliative care may use more hospice, and simply encouraging the use of hospice in facilities without this culture may have no effect.

In both the nursing home and home health settings, increased monitoring, assessment, and the use of data appear to reduce hospitalizations. It is not clear whether the key element in reducing hospitalizations was the standardized assessment process itself or the system of triggers prompting attention to particular care needs after assessment. Most LTC providers are already required to complete regular patient assessments. More detailed analysis of how standardized data are being used in clinical decision making in LTC is needed, including the extent to which evidence-based care protocols are being used in the decision-making process. Further studies of the potential for hospice care to reduce hospitalizations should focus on stronger research designs that may improve the ability to draw causal inferences.

Policy Interventions

In this section, we focus on two types of policy interventions: increasing the Medicaid rate in nursing homes and implementing risk contracting, which entails bundling hospitalization costs with other care costs to reduce LTC providers' incentive to hospitalize.

Low Medicaid reimbursement in nursing homes has been targeted as one reason for high hospitalization rates. Medicaid pays for the nursing home stays of the majority of long-stay residents in the average nursing home. Because Medicaid reimbursement is generally lower than other payers of nursing home care and because Medicare, not the nursing facility, pays for hospitalizations among the elderly, facilities may have a financial incentive to hospitalize Medicaid residents when they become ill as opposed to treating the illness in the facility. This incentive can be exacerbated by bed-hold policies in many states, which provide payment to the nursing home to hold a Medicaid resident's bed during the hospitalization. Using a nationally representative data set, Konetzka, Spector, and Shaffer (2004) find that Medicaid residents are significantly more likely to be hospitalized for suspected

pneumonia, generally a discretionary hospitalization, than other residents. In a study of nursing homes in 10 states, Intrator and Mor (2004) find that homes in states with higher Medicaid reimbursement have lower hospitalization rates, controlling for confounding factors and the competing risk of death. A $10 higher daily Medicaid rate was found to be associated with a 9% reduction in the odds of hospitalization. These studies suggest that one effective policy intervention to reduce hospitalizations from nursing homes would be to mitigate the financial incentive to hospitalize Medicaid residents through risk contracting or other payment mechanisms such as raising the Medicaid rate.

Two approaches to risk contracting are the Evercare program for nursing homes and the Program of All-Inclusive Care of the Elderly (PACE) for community-based patients. The Evercare program, a Medicare risk-contracting arrangement with enhanced staffing, was already described in the staffing section and was shown to reduce hospitalizations. Because it is a complex intervention, it is not clear whether the effect is attributable to the risk contracting arrangement or the enhanced staffing. PACE is a program that receives capitated payments from Medicare and Medicaid for its members. The payment bundles hospitalization costs with other care costs, thus providing an incentive not to hospitalize. Care is centered at an adult day care center and emphasis is placed on primary care in an effort to prevent nursing home admissions and hospitalizations. A study of PACE concluded that hospitalization rates among PACE members are similar to hospitalization rates among all Medicare beneficiaries even though PACE has a more disabled population (Wieland et al. 2000). A program with similar risk contracting in Minnesota was found to be associated with fewer hospitalizations, but the lower hospitalization rate was attributed to members in nursing homes with Evercare contracts; the capitated payment itself could not be associated with reductions in hospitalization beyond what was already attributable to Evercare (Kane et al. 2004). The Minnesota program involved a looser structure than the PACE program, suggesting that aligning financial incentives is necessary but not sufficient for reducing hospitalizations.

Because RCTs are often infeasible with policy interventions, the articles with policy interventions that met our study criteria all employed quasi-experimental designs to identify potential causes of hospitalizations from LTC settings and interventions that may reduce them. Several of these studies are associated with multifaceted interventions such as Evercare. The studies in this category reveal a range of rigor in methodological approach and research design, with most accounting for hierarchical structure in the data, potential nonlinearities in the outcome or in the effects of interest, and a variety of potential confounders. Nonetheless, the case for causality is sometimes questionable due to the inevitable danger of selection bias in observational studies, and these interventions could benefit from a larger body of work employing a variety of designs to establish consistency of results.

The two main policy interventions raised by the studies in this category both address financial incentives for hospitalization: raising the Medicaid rate and risk

contracting. Research on the second intervention is stronger in that the research designs allow slightly less potential for confounding and selection bias. Furthermore, experimentation with risk contracting is likely to be politically more feasible than increasing the Medicaid rate. Future research on risk contracting programs such as Evercare and PACE should focus on identifying key components and testing the applicability of the system in a variety of locations and situations so that the consistency of results can be examined.

Risk Factors and Additional Potential Interventions

This review excluded studies that simply identified risk factors for hospitalizations without a clearly identified intervention to reduce them. However, it is important to note that a significant body of work addresses risk factors that are organizational or policy-related and could potentially contribute to reductions in hospitalizations if specific interventions are identified and tested. One of the most important of these is polypharmacy, or the use of multiple prescription medications among the frail elderly. For example, one observational study found that nursing home residents with potentially inappropriate prescriptions had higher hospitalization rates (Lau et al. 2005) while a second connected the use of antipsychotic drugs with an increased risk of injurious falls leading to hospitalization (Mustard and Mayer 1997). The implicit intervention suggested by these studies is increased monitoring of medication prescriptions and anticipation of potential adverse drug reactions or interactions, but it is unclear from the literature exactly how one does that. Specific interventions to reduce polypharmacy and associated hospitalizations should be developed and rigorously tested.

Another apparent risk factor for higher hospitalization rates is for-profit ownership of a nursing facility. For example, five studies found that hospitalization rates are substantially higher with for-profit ownership of an assisted living facility (Zimmerman et al. 2002) or a nursing home (Carter and Porell 2003; Konetzka, Spector, and Shaffer 2004; Murtaugh and Freiman 1995; Spector, Selden, and Cohen 1998). The magnitude of the nonprofit effect varies widely, ranging from 9% lower hospitalization rates controlling for case-mix to 50% without adjustment for case-mix. These studies suggest that encouraging nonprofit ownership may possibly reduce hospitalizations, but that the payer source of individual nursing home residents may modify the ownership effect. However, this conclusion is based on associations where the case for causal inference cannot be made; the differences could be due to unmeasured heterogeneity. Nonetheless, further research could result in interventions that build on these findings.

Finally, some of the literature suggests that the timing of evaluation is important in the hospitalization decision. For example, several studies found that skilled nursing facility residents who were evaluated for a variety of conditions (urinary tract infection, heart failure, pneumonia) during nighttime or weekend shifts were sub-

stantially more likely to be hospitalized than their counterparts evaluated during the day (Hutt et al. 2002, 2003; Rector et al. 2005). This suggests the need for more resources at night and on weekends, in particular staffing, but a number of factors may be at play, and the particular intervention stemming from these findings remains an area for further research.

Discussion

This article reviewed the evidence on LTC interventions designed to reduce hospitalization rates among elderly LTC recipients. We began by identifying articles in the 1990–2005 peer-reviewed literature that describe sound experimental or quasi-experimental studies of hospitalization involving LTC interventions. We then classified the interventions into five broad types and assessed the evidence on each type and each subtype of intervention within the broader categories. We identified interventions with the most potential for reducing hospitalizations, with the goal of providing a useful tool for policy and practice as well as future research. Identifying interventions likely to have the most potential to reduce hospitalizations is a difficult process of balancing the strength of the evidence (in terms of the number of studies, consistency of results, and methodology used) on different interventions, the expected magnitude of the effect of the intervention, and the number of people likely to be affected. Based on these criteria, we found the following five interventions to hold the most promise:

1. use of nurse practitioners and physician assistants,
2. increasing RN staffing in LTC facilities,
3. improving the hospital-to-home transition,
4. substituting home health care for hospital days, and
5. aligning financial incentives.

Table 2 summarizes these five strategies, two of which were from the Staffing category and none of which was from the Prevention of High-Risk Clinical Problems or Systems of Quality Improvement categories. The first strategy has been used in nursing homes to provide more intensive primary care to long-stay nursing home residents. Because nurse practitioners and physician assistants can provide more expertise than RNs and other nursing staff but are cheaper than physicians, the evidence points toward their use as a cost-effective strategy to reduce hospitalizations substantially. RN staffing in nursing homes has been a key focal point of policy makers in recent years. Evidence points toward a consistent relationship between more RN staffing and better outcomes, including lower hospitalization rates, though the exact nature of that relationship is unclear. Among non–nursing home LTC populations, especially those with COPD and CHF that tend to have frequent hospital readmissions, home health programs designed to ease the transition to home and delay

or prevent readmission, or to substitute for all or part of the hospitalization, seem to have the intended effect of reducing hospital admissions without other adverse outcomes. Finally, there is substantial evidence that nursing homes have a financial incentive to hospitalize residents who get an acute illness even when the illness could be treated in the facility, and eliminating these incentives could have a substantial impact on hospitalization rates. While the strategies to address these incentives may be multifaceted, political, and difficult to study, Medicare risk contracting offers a more concrete example of a feasible intervention that realigns financial incentives to reduce hospitalizations.

While each of these approaches is based on sufficient evidence to reveal the potential for a substantial reduction in hospital admissions, days, or costs, each has caveats and could benefit from additional research. While some of the quasi-experimental designs used to show the benefit from the use of physician extenders are quite strong and employ several different control groups, the number of studies on this subject is small and selection biases cannot be ruled out. Studies of the benefit from higher RN staffing, while fairly consistent in direction and significance, are almost entirely cross-sectional and observational. It is still unclear whether increasing RN staffing causes an improvement in outcomes, or whether unmeasured factors such as facility culture drive the effect. Further research is needed on the mechanisms by which higher staffing may influence outcomes, preferably with research designs that are less prone to selection bias. The cost-effectiveness of increasing RN staffing is also unknown. The effectiveness of increasing any type of staff, including nurse practitioners and physician assistants as well as RNs, is subject to the additional limitation that increases in the number of staff reflect only one aspect of the effect of staff on outcomes. For example, training and quality of staff may vary by geographic location. Further research on regional or state variation in staff training, and the potential effect of this variation on the effectiveness of increasing staffing ratios, would be useful.

Studies of the use of home health to improve care during the transition from hospital to home and of home health to substitute for hospital days are much more likely to be based on RCTs and therefore the evidence on cause and effect is stronger. However, with some exceptions, these studies have been conducted among limited populations of COPD and CHF patients. While these populations are the most likely to benefit from this approach and are large in and of themselves, more research determining whether the benefit is limited to these high-risk populations would be useful. Finally, evidence on the approach of aligning financial incentives suffers from the same drawbacks as the first two: while the evidence on direction of effect seems consistent, the studies are inevitably observational and magnitudes of the potential effect are difficult to ascertain.

While the evidence base is still in early stages of development, the Evercare program and others like it appear to be particularly promising in their potential

(text continues on p. 61)

Table 2
Long-Term Care Interventions With the Strongest Potential to Reduce Hospitalizations

Intervention	Example/Detail	Evidence on Magnitude of Effect	Caveat
Use of nurse practitioners and physician assistants	Nurse practitioners and/or physician assistants are employed by the insurer to provide intensive primary care to members in the nursing home, thereby reducing the need for acute services. Often implemented as part of Medicare risk contracts under which the insurer has an incentive to reduce hospitalizations.	Evidence suggests 30% to 80% lower hospitalization rate and hospital costs; while evidence on cost-effectiveness varies, direction is consistently in favor of using physician extenders.	Based largely on well-designed but observational, nonrandomized studies; selection issues may still play a role.
Increasing registered nurse (RN) staffing in long-term care facilities	Require or encourage facilities to increase RN staffing ratios; RN staffing can be increased in an absolute sense or as a percentage of total staffing. Applies mainly to institutional care. Most studies pertain to increasing staff-to-resident ratios while ignoring quality or tenure of staff. Appears to be especially important to ensure adequate RN staffing during night and weekend shifts.	Studies vary widely in measures used and estimated magnitudes therefore also vary widely; generally, the estimated magnitudes are large enough to be of practical significance.	Cost-effectiveness is unclear. In addition, the evidence is based largely on observational, nonrandomized studies. Selection issues may still play a role.
Improving the hospital-to-home transition	May include a combination of predischarge education, postdischarge phone calls or phone access, follow-up home visits, and improved	Estimates of magnitudes vary in time of measurement but are generally consistent in direction and of practical significance. They range from a 22% reduction	Conducted mostly among congestive heart failure (CHF) patients, but potentially applicable to broader/other populations.

	communication between clinicians in different settings. Programs range in intensity, length of time, and personnel-RNs, MDs, physician extenders, nurse aides, or a combination. Goal is to ease the transition to home and thereby prevent or delay hospital readmissions for chronically ill. Having some transitional home health care (compared with none) appears to be the crucial aspect of the intervention; differences in details of each program appear to have only marginal effects, if any.	in readmissions at 6 months postdischarge to a 62% reduction in readmissions at 8 weeks.	
Substituting home health care for hospital days	Some interventions divert patients from the emergency room (ER) to specialized home health instead of admitting to the hospital. Others reduce the hospital length of stay by discharging early to specialized home health care. Specialized home health generally includes a patient/family educational session, regular nurse visits (usually daily), and telephone access to a nurse and/or physician.	Evidence suggests that there is no significant risk in substituting home health care for hospital days as measured by the risks of readmission and mortality. Estimates of cost savings from this substitution are reported as roughly $1,000 per patient in several studies and a reduction of 50% in another study.	Conducted mostly among chronic obstructive pulmonary disease (COPD) patients subject to strict inclusion criteria, but potentially applicable to broader/other populations. Evidence on cost savings is preliminary and incomplete.

(continued)

Table 2 (continued)

Intervention	Example/Detail	Evidence on Magnitude of Effect	Caveat
Aligning financial incentives	Policy interventions that reduce nursing homes' financial incentive to hospitalize residents. These include encouraging not-for-profit status and raising the Medicaid rate. Most common approach is Medicare risk models of payment for long-stay nursing home residents in which hospitalization costs are included in capitated payment.	Estimates of the degree to which encouraging not-for-profit status or raising the Medicaid rate would lower hospitalization rates from long-term care facilities are extremely varied. Evidence suggests 30% to 80% lower hospitalization rate and hospital costs under Medicare risk models compared with the current payment system.	Much of the evidence is based on observational studies where the intervention is implicit. However, several explicit evaluations of programs such as Evercare provide support for the effect of the intervention.

to reduce hospitalizations from nursing homes. It employs two of the approaches discussed here, that of using nurse practitioners and physician assistants to provide more intensive primary care of long-stay nursing home residents and Medicare risk contracting so that insurers and providers are not faced with a financial incentive to hospitalize. While the evaluations of these programs are not randomized trials, they employ strong quasi-experimental designs that indicate effects of large practical magnitude, for example, a decrease in hospitalizations of 48% (Kane et al. 2003). Further research and policy experiments should attempt to disentangle aspects of the program that are essential and perhaps to expand key aspects of the program to other locations and payer groups.

These strategies have a number of key elements in common, despite addressing varied settings. First, and perhaps obviously, most of the interventions involve a greater intensity of care in the LTC setting. The home health interventions involve a greater intensity at home than patients would otherwise have, while the nursing home interventions involve a greater intensity in the nursing home than residents would otherwise have. There is a trade-off between care given in the hospital and care given in the LTC setting; it would be difficult to reduce resources spent on hospitalization without increasing the need for resources elsewhere. A related point of commonality is that the most promising interventions involve the provision of more primary care in the LTC setting. For example, the nurse practitioners employed in the Evercare program do not simply step in to provide extra care when an adverse event points to a potential hospitalization; they also provide increased primary care on an ongoing basis so that both adverse events and hospitalizations may be avoided. Similarly, the home health interventions that enhance transitions from hospital to home are based on increased primary care, patient education for self-care, and increased health monitoring. Even home hospitalization, which is more of a direct substitute for acute care, incorporates elements of primary care. The emphasis on increased skilled staffing raises the issue of workforce supply. While the challenges of recruiting a sufficient long-term care workforce are well-known, the results of this review underscore the importance of meeting that challenge in terms of reducing hospitalizations across LTC settings.

A third common element is a focus on communication, getting the right information to the right person at the right time. For people in transition from hospital it is reflected in efforts to educate patients about self-care, improve monitoring of health changes through home visits and other methods, and provide improved access to clinicians when problems arise. It also is reflected in nursing homes with efforts to standardize assessment data, tying these data to specific triggers and to clinical guidelines to enhance care planning and management.

A final and related point is that these five most promising interventions are not independent, as they may all rely to some extent on the alignment of financial incentives so that providers are willing to implement and sustain the improvements. The hiring of more staff has to pay off in terms of reduced costs to the same entity to be

an attractive or even feasible strategy; this is not the case across LTC today. In the case of home health care, Medicare often pays for the hospitalization and postacute home health care, so there should be no incentive to skimp on postacute care; primary care is, however, generally paid by other payers or out-of-pocket and those payers have little reason to worry about hospitalization costs that will be covered by Medicare. In nursing homes, only the Evercare experiment and the VA system align such incentives. In growing recognition of this issue, many states are experimenting with integrating Medicare and Medicaid benefits for dually eligible individuals with waivers from CMS; the Arizona Health Care Cost Containment System (AHCCCS), for example, has a statewide managed care program for individuals in need of LTC that covers acute and LTC services (AHCCCS 2007).

This review has identified several promising LTC interventions with the potential to reduce hospitalizations among elderly LTC recipients. While many of them could benefit from more research, it seems that the dual goals of reducing health care costs and improving the quality of care by reducing hospitalizations may be within reach. Achieving these goals, however, would require a more systemic view and increased cooperation across payers and LTC settings.

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