

## Hazards of Hospitalization of the Elderly

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■ For many older persons, hospitalization results in functional decline despite cure or repair of the condition for which they were admitted. Hospitalization can result in complications unrelated to the problem that caused admission or to its specific treatment for reasons that are explainable and avoidable.

■ Usual aging is often associated with functional change, such as a decline in muscle strength and aerobic capacity; vasomotor instability; reduced bone density; diminished pulmonary ventilation; altered sensory continence, appetite, and thirst; and a tendency toward urinary incontinence. Hospitalization and bed rest superimpose factors such as enforced immobilization, reduction of plasma volume, accelerated bone loss, increased closing volume, and sensory deprivation. Any of these factors may thrust vulnerable older persons into a state of irreversible functional decline.

■ The factors that contribute to a cascade to dependency are identifiable and can be avoided by modification of the usual acute hospital environment by deemphasizing bed rest, removing the hazard of the high hospital bed with rails, and actively facilitating ambulation and socialization. The relationships among physicians, nurses, and other health professionals must reflect the importance of interdisciplinary care and the implementation of shared objectives.

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Hospitalization is a major risk for older persons, particularly for the very old. For many, hospitalization is followed by an often irreversible decline in functional status and a change in quality and style of life (1). A recent study showed that of 60 functionally independent individuals 75 years or older admitted to the hospital from their home for acute illness, 75% were no longer independent on discharge, including 15% who were discharged to nursing homes (2).

In many cases the decline cannot be attributed to the progression of the acute problem for which they are hospitalized. Even when the disease, such as pneumonia, is cured in a few days, or the hip fracture repair is technically perfect and uncomplicated, the patient may never return to the premorbid functional status. Between 30% and 60% of patients with hip fractures are discharged from the hospital to nursing homes; 20% to 30% of those persons still reside in nursing homes 1 year later (3-6). Only 20% of one large group of

patients returned to their preoperative functional level after repair of a hip fracture (7).

Some of the decline can be attributed to particular complications of the disease itself or to its management. Adverse drug reactions are an example of the latter. However, many elderly persons are susceptible to other complications not directly related to the illness or injury for which they were hospitalized or the specific treatment of the problem.

Usual aging is associated with changes that increase susceptibility to various stresses. Some of these changes represent loss of reserve function and do not produce disability under ordinary circumstances. However, the elderly are vulnerable and stand at the threshold of functional disability, at risk of being projected over that threshold when stressed.

### Interaction of Aging and Hospitalization

A number of explainable factors associated with hospitalization and bed rest, individually and collectively, thrust the elderly into disability. They are described in detail by Harper and Lyles (8), Hoenig and Rubenstein (1), and Mobily and Kelly (9). These factors initiate a cascade of events (Figure 1) that frequently culminate in diminished quality of life. I outline some of the functional capacities that change with usual aging and that are further modified by hospitalization, along with the functional consequences of the interaction (Table 1).

### Muscle Strength and Aerobic Capacity

Muscle mass and muscle strength are reduced with aging, which may reflect the progressive loss of reserve capacity associated with reduction of physical activity with age. Aerobic capacity is also progressively lost (maximum oxygen uptake,  $VO_{2\text{ max}}$ ), and research indicates that the loss is not cardiac in origin but the result of reduced peripheral use of oxygen related to the diminished muscle mass and strength as well as the capacity to respond to exercise (10).

Muscle contractions of certain minimal force and frequency are necessary to maintain strength. In the absence of any voluntary contraction, muscle strength decreases by 5% per day. Young men at bed rest lose muscle strength at the rate of 1.0% to 1.5% per day (10% per week) (11). Inactivity rapidly contributes to muscle shortening and changes in periarticular and cartilaginous joint structure, which contribute to a tendency toward limitation of motion and contracture. The most rapid changes take place in the lower extremities (12). Bed rest markedly diminishes aerobic capacity with substantial reductions in  $VO_{2\text{ max}}$  values.

For older persons who have diminished physiologic reserves but still can attend to their ambulation, toilet-

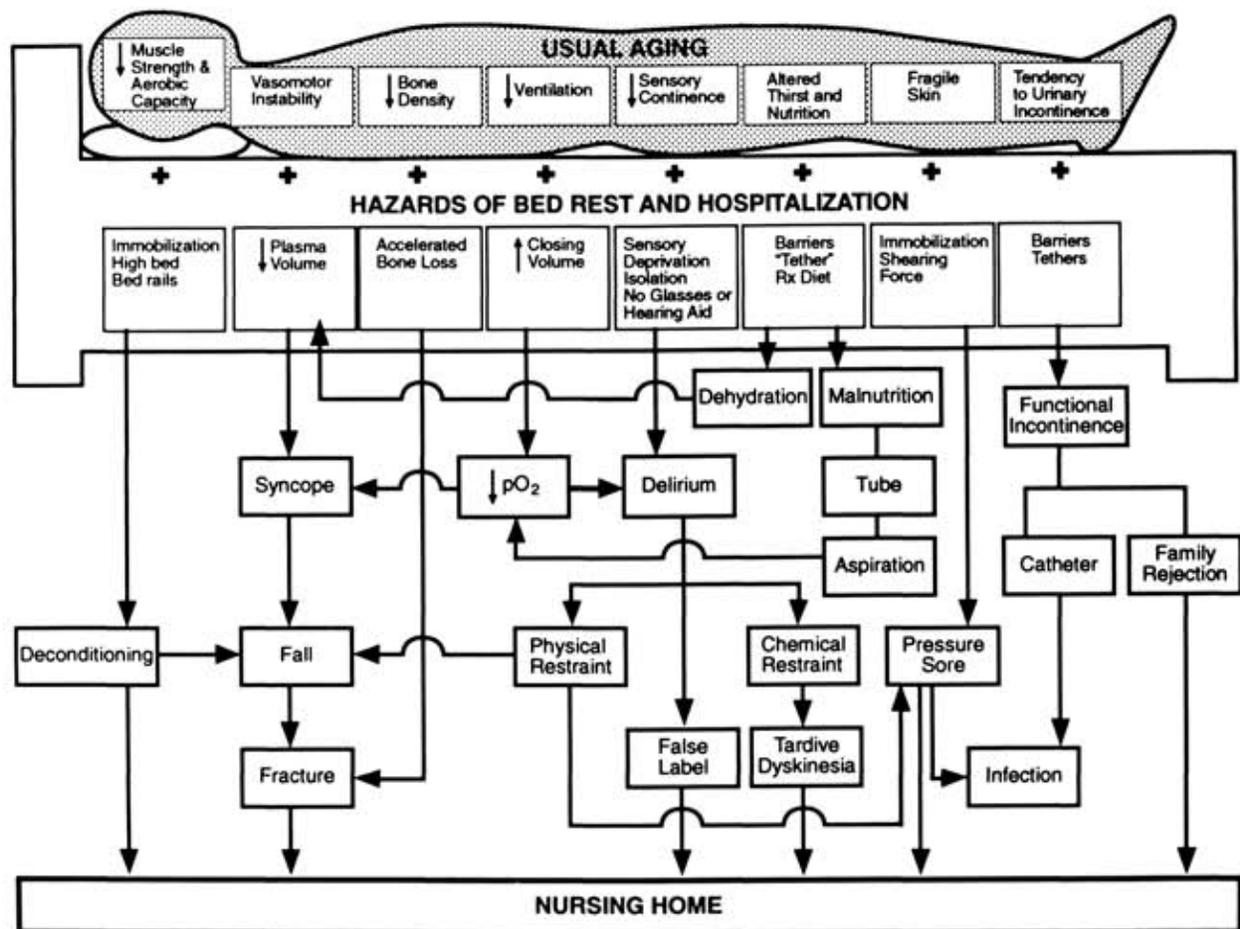


Figure 1. The cascade to dependency.

ing, bathing, and other daily functions, the accelerated loss of muscle strength and aerobic capacity after a few days of bed rest may result in future dependency in carrying out those activities. Even if reversible, long periods of rehabilitation will be required because reconditioning time is longer than deconditioning time (13).

Loss of muscle strength is also a major cause of falls in the elderly and may contribute to the many falls that occur in the hospital, particularly as the patients try to climb over the rails of the usual high hospital bed.

#### Vasomotor Stability

With increasing age, one of the most clinically important manifestations of alteration in autonomic function is baroreceptor insensitivity. The resultant tendency toward syncope is increased by the age-associated reduction in body water and plasma volume and may be further increased by disease-associated dehydration.

Bed rest in the supine position results in loss of plasma volume averaging about 600 mL (14). This loss contributes to the propensity for postural hypotension and syncope already associated with usual aging.

Syncope under any circumstance can result in injury. The possibility of injury is increased if syncope occurs while getting out of a high hospital bed in a strange environment. Additional risk factors, described next, compound the consequences.

#### Respiratory Function

The mechanics of respiration are altered with aging. Costochondral calcification and reduction in muscle strength diminishes ribcage expansion. The residual capacity increases and occupies a greater proportion of total lung capacity (15). The closing volume increases and greater numbers of dependent alveoli fail to ventilate as a result of airway closure (16). The combination of effects on pulmonary ventilation reduces arterial oxygen tension ( $P_{O_2}$ ) so that a value of 70 to 75 mm Hg is not uncommon in a 75-year-old person. This reduction in arterial oxygen pressure produces little functional disability in a healthy elderly person.

The supine position reduces ventilation even more by increasing the closing volume (17) enough to cause an additional fall in  $P_{O_2}$  of 8 mm Hg in a healthy elderly person. The further reduction in  $P_{O_2}$  may be sufficient to produce symptoms such as confusion in an elderly person at the threshold of pulmonary insufficiency. It may also contribute to the occurrence of syncope in persons already sensitized by vasomotor instability.

#### Demineralization

Involuntary loss of bone mineral begins in early adulthood, is accelerated with the menopause, and varies in occurrence. Many elderly persons, particularly

thin, white women, are osteoporotic and are at risk for fractures.

It has been shown that vertebral bone loss accelerates to 50 times the involuntional rate in healthy men on bed rest (18). The loss incurred with 10 days bed rest required 4 months to restore. Some of the loss is due to lack of weight bearing, but the general negative nitrogen balance associated with immobilization probably contributes to the problem.

The frequent falls that occur in hospitalized elderly, caused by factors already described, have increased the likelihood of fractures, particularly hip fractures.

#### Urinary Incontinence

With aging comes an increased tendency for urinary incontinence. Bladder capacity is reduced. In older men, prostatic hypertrophy is almost universal. Many women suffer relaxation of the pelvic floor and also vaginal atrophy. Uninhibited contractions of the detrusor muscle increase. However, only 5% to 15% of community-dwelling elderly persons are actually incontinent (19). Others at risk are spared embarrassment by consciously and unconsciously developing strategies for toileting at appropriate times.

Many hospitalized patients have difficulty implementing their habitual strategies to avoid incontinence. The environment is unfamiliar, and the path to the toilet may not be clear. The high bed may be intimidating; the bed rail, an absolute barrier; and the various "tethers," such as intravenous lines, nasal oxygen lines, and catheters, become restraining harnesses. Psychotropic agents may reduce the perception of the need to void.

About 40% to 50% of hospitalized persons over age 65 are incontinent (19), many within a day of hospitalization. The functional incontinence that occurs in the hospital explains the discrepancy between incontinence rates in community-dwelling and newly hospitalized patients.

#### Skin Integrity

With aging come changes in the skin: thinning of the epidermis and dermis, reduction in vascularity, de-

crease in epidermal turnover, and loss of subcutaneous fat. Direct pressure on the skin greater than the capillary perfusion pressure of 32 mm Hg for as little as 2 hours results in skin necrosis in anyone. After short periods of immobilization, sacral pressures reach 70 mm Hg, and the pressure under the unsupported heel averages 45 mm Hg. Unusual shearing forces result from movement in a jacked-up bed or wheelchair.

Pressure sores occur frequently in hospitalized elderly patients usually developing within hours of immobilization. The rate may be accelerated in the case of the incontinent patient in a wet bed or chair.

#### Sensory "Continence"

An increased propensity to confusion with minimal provocation comes with aging. It can be partially explained by age-associated reduction in sensory input. Frequency of visual loss is increased as a result of presbyopia, cataract, and other eye problems. Hearing loss is variable but common. However, there are undoubtedly other factors related to the jumble of neurotransmitter, neurophysiologic, and neuroanatomic changes that are described in the literature and await explanation.

Sensory deprivation or overstimulation results in confusion and delirium in normal people at any age if of sufficient intensity and duration. Twenty-nine percent of young persons placed in a simulated hospital room developed subjective sensory distortions after 2.5 hours (20).

The reduction of sensory input of all types that occurs with immobilization can produce intellectual and perceptual disorders (21). It is not surprising that an elderly person, admitted to a hospital bed in a quiet room with subdued lighting, whose eyeglasses and hearing aid were left at home, suffers delirium. If the sensory deprivation alone were not enough, add the possibility that he or she awakens in a strange bed after a period of anesthesia or coma.

#### Nutritional Status

Dietary habit is deeply ingrained. Age-associated loss of taste and smell makes change in dietary habit even

**Table 1. Interaction of Aging and Hospitalization**

Changes with Usual Aging	Contribution of Hospitalization	Potential Primary Effects	Potential Secondary Consequences
Reduced muscle strength and aerobic capacity	Immobilization, high bed and rails	Deconditioning, fall	Dependency
Vasomotor instability	Reduced plasma volume	Syncope, dizziness	Fall, fracture
Baroreceptor insensitivity and reduced total body water	Inaccessibility of fluids		
Reduced bone density	Accelerated bone loss	Increased fracture risk	Fracture
Reduced ventilation	Increased closing volume	Reduced PO <sub>2</sub>	Syncope, delirium
Reduced sensory continence	Isolation, lost glasses, lost hearing aid, sensory deprivation	Delirium	False labeling, physical restraint, chemical restraint
Altered thirst, taste, smell, and dentition	Barriers, "tethers," therapeutic diets	Dehydration, malnutrition	Reduced plasma volume, tube feeding
Fragile skin	Immobilization, shearing forces	Pressure sore	Infection
Tendency to urinary incontinence	Barriers, "tethers"	Functional incontinence	Catheter, family rejection

less desirable. The sensation of thirst also diminishes with advancing age. Problems with dentition are more common in the elderly as is the dependence on dentures if nutrition is to be maintained.

Under the best of circumstances, hospital food is unfamiliar. Therapeutic diets, such as those low in salt, are apt to make food less appealing. Eating in bed is difficult with trays, utensils, and water not easily accessible, particularly if bed rails and restraints limit reach. A delay usually occurs between the time when the tray of food is delivered to the room and when someone arrives to help the patient—an interval long enough to allow the food to cool and become even less appealing.

Malnutrition and dehydration can occur rapidly in hospitalized patients of any age. Anorexia is a feature of many illnesses for which patients are hospitalized. The addition of the factors noted already put the elderly patient at particular risk. In the 85-year-old patient whose thirst perception is decreased, thirst may have to be compelling before he or she exerts the effort to grasp a glass of water that is out of reach. If, as is so often the case, dentures have been left at home or misplaced, all the other problems become secondary.

### The Cascade of Interactions

As illustrated in Figure 1, the consequences of individual interactions between the effects of usual aging and hospitalization are, in turn, likely to interact with each other, producing additional tiers of disability in the cascade toward dysfunction and the final common pathway to dependency.

Many factors contribute to the falls and fractures that are all too common in hospitalized older persons. There is adequate explanation for the frequent occurrence of delirium and its consequences. The actual and perceived disability created by fractures, delirium, pressure sores, and functional incontinence all contribute to the frequency with which hospitalized older patients are discharged to nursing homes.

Additionally, Medicare-imposed restraints on the length of hospitalization grease the skids down the cascade toward the final common pathway to the nursing home.

### The End Result

A high percentage of hospitalized elderly persons discharged to nursing homes never return to their homes or community. In one study, 55% of persons over age 65 who entered nursing homes remained for more than a year (22). Many of the others were discharged to other hospitals or long-term-care facilities or died. In another study, only 12% were eventually discharged to home (23). Even if the intent is for a temporary stay until rehabilitation occurs or arrangements can be made for home care, circumstances frequently dictate otherwise. The family or other informal caretaker may discover the advantage of respite during the separation. Available helpmates may disappear from the scene. The apartment rental may have lapsed. The spend-down for nursing home care may have left insufficient funds to get started again. Perhaps the most important fact is

**Table 2. Recommendations for Modification of Physical and Functional Environment**

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Ambulation
Low beds without rails
Carpeting
Encouragement and assistance
Minimization of "tethers"
Reality orientation
Clocks
Calendars
Dressing and undressing
Communal dining
Increased sensory stimulation
Proper lighting and decorating
Attention to glasses and hearing aids
Newspapers and books
Available recreation
Functional change
Primary care concept
Team management
Interdisciplinary rounds
Sharing of objectives
Family participation
Early discharge planning

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that many nursing homes do not have the resources to rehabilitate their charges back to their prehospitalization levels of function.

The ultimate outcome for many hospitalized elders is loss of home and, ultimately, loss of place.

### Recommendations

The negative effects of hospitalization begin immediately and they progress rapidly. Hirsch and colleagues (24) have shown that functional decline from baseline occurs by the second day of hospitalization and improves little by discharge. The techniques of formal geriatric assessment applied to each hospitalized elderly patient should theoretically identify risk factors that would predict the propulsion into the cascade to dependency produced by hospitalization. Unfortunately, the typical time frame for conduct of assessment is not consistent with the speed with which deterioration can occur. By the time the assessment team meets on Tuesday to discuss the patient who was admitted to the hospital last Wednesday, the damage has already been done. By the time the need for consultation is recognized, the problems have evolved. Until assessment recommendations are put into practice, additional time has passed. The risk should be predicted before the assessment or consultation.

Although the formal assessment process provides a useful data base for determining long-range patient management and for evaluating the effects of intervention, the time it takes might actually delay the initiation of care that is predictably beneficial and is unlikely to be harmful in any case. If this premise is accepted, then the hospital environment into which elderly persons are admitted should be modified on the assumption that for many, hospitalization will propel them over the "threshold of frailty." It is essential that the paradigm of acute hospitalization be adapted to the needs of the hospital's most frequent customer (Table 2).

I know of no evidence that shows the therapeutic value

of bed rest. The "ambient" condition should be for the patient to be out of bed except for a particular reason. High beds are for the convenience of the staff, not the patient. Patients do not *fall* out of bed in the hospital any more than they *fall* out of bed at home. They are injured as they *climb* in and out of high beds. Modified, less hazardous hospital beds are on the market and should replace those in common use. Carpeting, which can provide safe footing and which is easily maintained, is now available.

Not every patient needs an intravenous line, although it may justify the hospitalization. The needs of many hospital patients could be met with appropriate fluids placed where they can be reached and offered on a timely basis. The availability of needed dentures may obviate the need for enteral or parenteral nutrition. Proper lighting, clocks, calendars, communal eating, daily dressing and undressing in personal clothing, and other efforts to provide reality orientation will provide therapeutic benefits no less important than those prescribed for the condition causing the hospitalization. Involvement by social services from the time of admission rather than at the time of discharge will often obviate the need for nursing home placement.

Most importantly, relationships among physicians, nurses, and other health professionals need to reflect the interdisciplinary care required by the elderly, even on acute care units. Mutual objectives require expression beyond the simple writing of an order by a physician and its execution by a nurse. Just as an attending physician is responsible 24 hours a day for a particular patient, so must there be a nurse with an equivalent relationship to the patient. Doctor and nurse must work in partnership. They must make rounds together on a daily basis and convey the shared objectives to all members of the care team on all shifts. It is essential that all personnel assigned to units on which elderly patients reside understand the unique requirements for their care and share in implementing the details of that care. Everyone who has contact with the patient throughout the day, including doctors, nurses, and family members, should offer encouragement and assistance with ambulation, not just the physiotherapist during the 15-minute formal session once or twice a day. "High tech" medicine requires particular attention to "high touch" care if its recipients are to enjoy its rewards.

A few studies (25-29) of the effectiveness of specially designed units on the outcomes of acute hospitalization of the elderly have been reported but not in journals read by the clinicians who usually care for most of the older patients. If the preliminary results are confirmed, then such units should serve as models for rapid change in the pattern of care offered by acute care hospitals.

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#### References

1. Hoening HM, Rubenstein LZ. Hospital-associated deconditioning and dysfunction [Editorial]. *J Am Geriatr Soc.* 1991;39:220-2.
2. Lamont CT, Sampson S, Matthias R, Kane R. The outcome of hospitalization for acute illness in the elderly. *J Am Geriatr Soc.* 1983;31:282-8.
3. Fitzgerald JF, Moore PS, Ditters RS. The care of elderly patients with hip fracture. Changes since implementation of the prospective payment system. *N Engl J Med.* 1988;319:1392-7.
4. Palmer RM, Saywell RM Jr, Zollinger TW, Erner BK, LaBov AD, Freund DA, et al. The impact of the prospective payment system on the treatment of hip fracture in the elderly. *Arch Intern Med.* 1989;149:2237-41.
5. Kellie SE, Brody JA. Sex-specific and race-specific hip fracture rates. *Am J Public Health.* 1990;80:326-8.
6. Furstenberg AL, Mezey MD. Community residence one year after hip fracture. *American Journal of Applied Gerontology.* 1988;7:193-204.
7. Jette AM, Harris BA, Cleary PD, Campion EW. Functional recovery after hip fracture. *Arch Phys Med Rehabil.* 1987;68:735-40.
8. Harper CM, Lyles YM. Physiology and complications of bed rest. *J Am Geriatr Soc.* 1988;36:1047-54.
9. Mobily PR, Skemp Kelley LS. Iatrogenesis in the elderly. Factors of immobility. *J Gerontol Nurs.* 1991;17:5-11.
10. Lakatta EG. Heart and Circulation. In: Schneider EL, Rowe JW; eds. *Handbook of the Biology of Aging.* 3d ed. San Diego: Academic Press Inc.; 1990:195-6.
11. Muller EA. Influence of training and of inactivity on muscle strength. *Arch Phys Med Rehabil.* 1970;51:449-62.
12. Greenleaf JE, Van Beaumont W, Convertino VA, Starr JC. Handgrip and general muscular strength and endurance during prolonged bedrest with isometric and isotonic leg exercise training. *Aviat Space Environ Med.* 1983;54:696-700.
13. Booth FW. Physiologic and biochemical effects of immobilization on muscle. *Clin Orthop.* 1987;219:15-20.
14. Vogt FB, Johnson PC. Plasma volume and extracellular fluid volume change associated with 10 days bed recumbency. *Aerosp Med.* 1967;38:21-25.
15. Druz WS, Sharp JT. Activity of respiratory muscles in upright and recumbent humans. *J Appl Physiol.* 1981;51:1552-61.
16. Leblanc P, Ruff F, Milic-Emili J. Effects of age and body position on "airway closure" in man. *J Appl Physiol.* 1970;28:448-51.
17. Ward RJ, Tolas AG, Benveniste RJ, Hansen JM, Donnica J. Effect of posture on normal arterial blood gas tensions in the aged. *Geriatrics.* 1966;21:139-43.
18. Kroemer B, Toft B. Vertebral bone loss: an unheeded side effect of therapeutic bed rest. *Clin Sci.* 1983;64:537-40.
19. Resnick NM, Yalla SV. Management of urinary incontinence in the elderly. *N Engl J Med.* 1985;313:800-5.
20. Downs FS. Bed rest and sensory disturbances. *Am J Nurs.* 1974;74:434-8.
21. Zubek JP, Wilgosh L. Prolonged immobilization of the body: changes in performance and in the electroencephalogram. *Science.* 1963;140:306-10.
22. Kemper P, Murdaugh CM. Lifetime use of nursing home care. *N Engl J Med.* 1991;324:595-600.
23. Sloane PD, Pickard CG. Custodial nursing home care. Setting realistic goals. *J Am Geriatr Soc.* 1985;33:864-8.
24. Hirsch CH, Sommers L, Olsen A, Mullen L, Winograd CH. The natural history of functional morbidity in hospitalized older patients. *J Am Geriatr Soc.* 1990;38:1296-303.
25. Saunders RH Jr, Hickler RB, Hall SA, Hitzhusen JC, Ingraham MR, Li L. A geriatric special-care unit: experience in a university hospital. *J Am Geriatr Soc.* 1983;31:685-93.
26. Boyer N, Chuang JLC, Gipner D. An acute care geriatric unit. *Nursing Management.* 1986;17:22-4.
27. Meissner P, Andolsek K, Mears PA, Fletcher B. Maximizing the functional status of geriatric patients in an acute community hospital setting. *Gerontologist.* 1989;29:524-8.
28. Huber M, Kennard A. Functional and mental status outcomes of clients discharged from acute gerontological versus medical/surgical units. *J Gerontol Nurs.* 1991;17:20-4.
29. Palmer R, Landefeld S, Kresevic D, Kowal J. A medical unit for the acute care of hospitalized elderly patients: conceptual basis and feasibility [Abstract]. *J Am Geriatr Soc.* 1991;39:A62.