2023

Patient Frailty: A Review

Lakshmi Sailaja Kodavati

Patient Frailty: A Review

Lakshmi Sailaja Kodavati

Submitted in partial fulfillment of the

Master of Healthcare Informatics

Harrisburg University of Science and Technology

Harrisburg, PA

Abstract:

According to Geriator (2011), frailty is a common clinical syndrome in older adults that carries an increased risk for poor health outcomes such as falls, incident disability, hospitalization, and mortality. An operational definition of frailty is the existence of at least three out of five observable criteria indicating compromised energetics: low grip strength; low energy; slowed walking speed; low physical activity; and unintentional weight loss (Fried, et al. 2001).

According to Dubois and Charpillet (2017), most transitions into frailty are due to unintentional weight loss which, in turn, impacts gait performance and subsequent general mobility. In this literature review, the focus is on those patients whose gait performance is compromised. As the common chain of events in this syndrome proceeds, poor gait performance results in low physical activity, decreasing muscular activity, and causing poor balance. Sarcopenia, exhaustion, poor gait performance and depression are primary risk factors for falls. This review also focuses on patients who are cared for at the home by the family physician, nurses, and family members.

Research Question: How do existing methods identify patient frailty and what interventions can reduce adverse health outcomes and health care costs as well as maintain living at home for frail patients?

Introduction:

Long-term care, usually including assistance with activities of daily living, which is provided in the home is labeled *home health care*. It includes various clinical services such as nursing care, drug therapy, physical therapy and environmental adaptations such as installing hydraulic lifts on stairs and renovating bathrooms and kitchens). The family physician, with the input of other care team members, often determines which type(s) of treatment should be offered to individual patients. Some services may be covered by government and/or commercial payors (Medicare/Medicaid or private health insurance) or, infrequently, family-financed long-term care insurance. In light of the rapidly aging population (Mitchell. 2014), advances in home medical technology and expansion of Medicare/Medicaid reimbursement, team-based home health care is becoming key to the success of community living for elderly and frail patients.

The "*Overview of Assisted Living Report*", using data from 2010, stated that 54 percent of assisted living residents are 85 years or older; 27 percent are 75–84 years old; nine percent of residents are between 65 and 74 years, and 11 percent are younger than 65 years old. Also, 74% of assisted living residents are female; 26 percent are male." (Goldbourt, Tanne & Ibrahim. 2016)

Literature Review:

Bock and colleagues reported the results of "Epidemiological investigations on chances of preventing, recognizing early and optimally treating chronic diseases in an elderly population", the ESTHER Study, which was a large prospective observational cohort study of older German citizens. The study investigated the relationship between frailty and health care costs in a large sample of older adults. (Bock, König, et al. 2016)

The relationship between frailty and health care costs was analyzed using generalized linear models (glm) to account for skewed cost data. Prevalence of frailty (≥3 symptoms) in the sample

population was 8.0 %. Mean total 3-month costs of frail participants were €3659 with 4 or 5 symptoms and €1616 with 3 symptoms compared to €642 for non-frail participants (no symptoms). Controlling for comorbidity and general socio-demographic characteristics in multiple regression models, they found the difference in total costs between frail and non-frail participants amounted to €1917; $p < .05$ (4 or 5 symptoms) and €680; $p < .05$ (3 symptoms). Among the five symptoms of frailty, weight loss and exhaustion were most significantly associated with total costs after controlling for comorbidities.

Of course, comparisons of published studies require an understanding of patient selection. Frailty can be assessed using several different methods with varying results. Selection can be based on family practitioners' data from electronic medical records, objective risk scores, and by self-reporting. One method uses a short questionnaire called the Groningen Frailty Indicator (GFI). Based on the resulting GFI score, patients are divided into three different groups: non-frail (GFI < 2), some frailty (GFI 2-3), and moderate to severe frailty (GFI ≥4).

The PRISMA-7 scoring system is based on an individual's functional autonomy as well as age and gender. It is recommended by both NICE and the British Geriatric Society (BGS) as an option for identifying frailty. It is simple and quick to use as it asks seven "yes" or "no" questions which can be self-completed. The questions are:

1. Are you older than 85 years?
2. Are you male?
3. In general, do you have any health problems that require you to limit your activities?
4. Do you need someone to help you on a regular basis?
5. In general, do you have any health problems that require you to stay at home?
6. In case of need can you count on someone close to you?
7. Do you regularly use a stick, walker or wheelchair to get about?

A cut-off score of 3 or more indicates frailty and the need for further clinical review. (Hébert, Durand, Dubuc & Tourigny. 2003).

Of course, technological sensors are also used to assess fragility. Gait speed sensors have been used as frailty indicators. Ibrahim, et al (2016) report on the analysis of older adults' gait performance using a "shin-worn inertial sensor" to investigate frailty diagnosis. Sensor-derived gait parameters distinguished different frailty stages as determined by the Fried Criteria. A neural network model was used to predict frailty stages.

This study emphasized the activity of the patient. The physical motion of a person was evaluated based on Hidden Markov Models. The trajectory of the patient's center of mass allowed measurement of the gait parameters. They suggested a sensor system could be installed in the home to provide daily information on a person's activity. (Ibrahim, Howson, Culliford & Sayer. 2019)

Another study used cameras to track the patient and look at body movements. The patient's center of mass was calculated as the geometric center of the silhouette. (Dubois, Charpillet. 2017). Comprehensive studies of monitoring and diagnostic sensor use have been published. Rahemi, et al. (2018) and Ooteghem & Trinh. (2017). These authors pointed out that frailty and its sequelae are associated with reduced quality of life for patients. Furthermore, frailty increases health care costs through increased specialist and emergency visits. Falls are frequent among frail patients, and they are a major cause of autonomy loss and removal from the home environment. They proposed a system using a RGB-D camera chosen for its depth reconstruction, low cost and light sensitivity.

Gait speed was identified as the strongest indicator of frailty. Wearable technologies have the potential to remotely screen and/or track changes in frailty and can provide continuous and unsupervised monitoring for patients. The development of gait-related metrics for identification of

frailty phenotypes should encourage the development of sensors such as smart footwear devices (smart socks, smart shoes) to assess frailty during daily activities. For example, weakness in propulsive muscle group is similar to grip force decline mentioned in the weakness phenotype. The loss of muscles mass (due to atrophy or dystrophy) may be correlated to shrinking phenotype (i.e., unintentional weight loss). Loss of muscle mass may be correlated with the shrinkage phenotype (unintentional weight loss) and result in diminished push off force, and this leads to reduction in gait speed. A reduction in range of motion in the legs leads to a decline in flexibility of joints. They hypothesized that gait parameters during the propulsion phase of muscle could be the strongest indicator of frailty status in the at-risk population.

They also constructed a predictive algorithm using an Artificial Neural Network (ANN) to assess its accuracy in predicting frailty status. The results showed 95% confidence in predicting the stage of frailty of the participants by monitoring proposed gait parameters, such as propulsion duration and propulsion time during walking. (Rahemi, Nguyen, Lee, & Najafi. 2018).

But are there any treatment regimens that can improve or at least minimize progression and maintain independent living for frail patients?

Nonpharmacologic treatment:

Involving ancillary health care providers, such as dietitians, social workers, home health care nurses, and immediate or extended family members, is beneficial in slowing or halting decline in frail patients. Increasing physical activity may stimulate appetite and result in modest weight gain. Nutritional supplements are a common modality in treating weight loss and often work best when used with other treatment options. Psychosocial intervention and medication management are

positive factors in maintaining home domicile for these patients. (Goldbourt, Tanne and Ibrahim. 2016).

Pharmacologic treatment:

Megestrol acetate is indicated for unexplained, significant weight loss in patients with AIDS. Dronabinol is indicated for weight loss in patients with AIDS and in patients with cancer undergoing chemotherapy. Other appetite stimulants or weight-gain–inducing medications include cyproheptadine, ghrelin, growth hormone, vitamin supplements, antidepressants, antipsychotics, and other mood-stabilizing drugs. Any of these drugs can be considered as part of the overall management plan for an individual frail patient. (Zahradnik, M., et al. 2017)

Discussion: Proactive assessment of frailty is likely to assist in optimizing health and reducing fall risk in the aging population. Timely treatment and interventions are usually planned and appropriately implemented when frailty is identified. Until recently, clinical assessment by a trained physician was necessary to evaluate patients' status. This review focused on wearable technology and diagnostic systems usable with little medical training.

Conclusion:

This literature review demonstrates the use of technology for assessing the status of potentially frail patents, especially during the propulsive phase of walking. Existing studies have developed and initially validated predictive models that could be used for unsupervised and real-time assessment of independently living patients using wearable or installed sensors. New and less expensive technologies should drive the development of single-sensor systems such as wearable footwear in order to assess frailty during daily living activities. The result would be longer independent living at lower healthcare costs and an increase in quality of life for the growing elderly population. Additional prospective studies should be done to assess efficacy.

References

Bock, J., König ,H., Brenner, H., Haefeli, W., Quinzler, R., Matschinger, H., Saum, K., Schottker, B., & Heider, D., (2016) Associations of Frailty with Health Care Costs – Results of the ESTHER Cohort Study , *BMC Health Service Researchers* (16):128.

Dubois, A., Charpillet, F., (2017), Measuring frailty and detecting falls for elderly home care using depth camera, *Journal of Ambient Intelligence and Smart Environment,* (9), 469-481.

Fried LP, Tangen CM, Walston J, et al. Frailty in older adults: evidence for a phenotype. *JGerontolA BiolSciMedSci.* 2001;56(3):M146–M156.

Geriator, C., (2011), The frailty syndrome: Definition and Natural history, U.S National Library of Medicine retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3028599/.

Goldbourt, U., Tanne, D., Ibrahim, K., (2016) Associations of frailty with health care costs – results of the ESTHER cohort study, *BMC Health Services Research,* 16:128.

Ibrahim, K., Howson, F., A., F., J.D., Culliford , Sayer, A. A., (2019) The feasibility of Assessing Frailty and Sarcopenia in Hospitalised older people: a comparison of commonly used tools, *BMC Geriatrics,* 19:42.

Mitchell, G., (2014) The Silver Tsunami. *Physician Executive Journal*; 40(4):34-38.

Ooteghem, V., K., Trinh, A., (2017) Using technology to Optimize Assessment of Balance and Mobility in the Frail Elderly, Canadian Frailty Network National Conference Abstracts Contributions, *Canadian Geriatrics Journal* (20), 142-143.

Hébert, R.,, Durand, P., Dubuc, N., Tourigny, A. (2003). Frail Elderly Patients: New model for integrated service delivery. *Can Fam Physician* (49):992-997.

Rahemi, H., Nguyen, H., Lee, H., & Najafi, B.,(2018), Toward Smart Footwear to Track Frailty Phenotypes- Using Propulsion Performance to Determine Frailty. *Sensors,* 18, 1763.

Zahradnik, M., Jeffs ,L., P., Mainville ,C., Maione,M., A. Morris, C. Bell, S., et al (2017) Frailty & Recognizing Appropriate Medications in Geriatrics & Long Term Care: Protocol, Canadian Frailty Network National Conference Abstracts Contributions, *Canadian Geriatrics Journal* (20), 141-142.