The impact of inpatient rehabilitation on outcomes for patients with cancer

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Background Patients with cancer have challenges around mobility, activities of daily living, and self-care.
Objective To report outcomes of patients who received radiation therapy while on an inpatient rehabilitation facility (IRF).
Methods 61 patients admitted to an IRF with either a primary malignant brain tumor, tumor metastatic to the brain, tumor metastatic to the spine with spinal cord injury, or tumor metastatic to bone. Each patient required radiation therapy. The study notes the outcomes of 69 patients admitted with stroke and 23 patients admitted with a traumatic spinal cord injury. Each patient was offered therapy in accordance with the Center for Medicare and Medicaid Services guidelines. Level of function was assessed using Functional Independence Measure. Outcome measures were improvement in function, functional level at discharge, length of stay, and percent discharged to home.
Results The patients in the cancer group had significant improvement in function. More than 75% of the patients with cancer returned to their homes. The functional level achieved by patients with primary malignancies of the brain or tumors metastatic to the brain was not significantly different than that of patients with stroke. The functional level achieved by patients with cancer metastatic to the spine was not significantly different than that of patients with a traumatic spinal cord injury. The percent of patients with cancer discharged to home was not significantly different than that of patients without cancer.
Limitations The study reports outcomes from only 1 IRF.
Conclusions Comprehensive care that includes radiation and rehabilitation at the IRF level benefits appropriately selected patients with cancer.

The American Cancer Society reports that 1.6 million people are diagnosed with cancer each year, of whom 78% are aged 55 years or older. The 5-year survival rate for cancer is 68%.[1] Almost 15.5 million living Americans have been diagnosed with cancer.[2] Many patients with cancer have difficulty walking and with activities of daily living. Patients with primary brain tumors or tumors metastatic to the brain may present with focal weakness or cognitive deficits similar to patients with stroke. Patients with tumors metastatic to the spine may have the same deficits as a patient with a traumatic spinal cord injury. Patients with metastasis to bone may have pathologic fractures of the hip or long bones. Patients may develop peripheral neuropathy associated with a paraneoplastic syndrome, chemotherapy, or critical illness neuropathy. Lehmann and colleagues evaluated 805 patients admitted to hospitals affiliated with the University of Washington Medical School with a diagnosis of cancer and found that 15% had difficulty walking and 20% had difficulty with activities of daily living.[3]

Many patients with cancer can benefit from inpatient rehabilitation.[4,5] Study findings have shown that patients with impairments in function related to cancer are often not referred for rehabilitation. Among the reasons mentioned for that are that oncologists are more focused on treating the patients' cancer than on their functional deficits and that specialists in rehabilitation medicine do not want to be involved with patients with complex medical problems. Rehabilitation facilities may not want to incur the costs associated with caring for patients with cancer.[6]

The present paper looks at the outcomes of 61 consecutive patients with cancer who were admitted to an inpatient rehabilitation facility (IRF) and received radiation therapy concurrent with rehabilitation. It compares the outcomes of the cancer patients with the outcomes of patients without cancer who were admitted with stroke or spinal cord injury, conditions more commonly treated at an IRF.

Methods

We reviewed electronic medical records of all patients with cancer admitted to the IRF from 2008 through 2013 who received radiation ther-

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TABLE 1 Demographics and analysis of admission Functional Independence Measure, discharge FIM, change in FIM, and length of stay for each subgroup

	n	Male: Female, %	Average age, y	ADM FIM[ab]	D/C FIM[ab]	Change in FIM[ab]	LoS, d	FIM efficiency	Disposition
Cancer population									
Overall	61	61.3 38.7	61.05	68.69	83.08	14.39	18.98	0.991	75.4%, home 18%, acute hospital 4.9%, subacute rehab 1.6%, death
Metastasis to bone	7	42.9 57.1	66.14	76.70	87.70	12.40	11.60	1.25	71.4%, home 28.6%, acute hospital
Primary brain cancer	23	60.9 39.1	55.04	63.40	83.30	19.40	20.78	1.19	82.6%, home 13%, acute hospital 4.3%, subacute rehab
Metastasis to brain	16	50 50	68.19	75.60	83.30	7.60	15.81	0.80	81.3%, home 12.5%, acute hospital 6.3%, subacute rehab
Metastasis causing SCI	15	80 20	60.27	66.50	80.40	13.90	22.93	0.78	60%, home 26.7%, acute hospital 6.7%, subacute rehab 6.7%, death
Stroke population									
Overall	69	40.6 59.4	69.13	63.12	87.52	24.40	16.80	2.00	85.5%, home 7.2%, acute hospital 7.2%, subacute rehab
Spinal cord injury population									
Overall	23	82.6 17.4	42.70	58.03	89.13	31.10	39.87	1.46	87%, home 13%, subacute rehab

ADM FIM, admission FIM; D/C FIM, discharge FIM; LoS, length of stay; SCI, spinal cord injury; FIM, Functional Independence Measure

[a]All FIM scores are averages. [b]A total FIM score of 78 best separates patients who are likely to be able to go home and those who are likely to need long-term care.[11]

apy while at the facility. We also reviewed the data of all patients without cancer admitted with a diagnosis of stroke in 2013 and all patients admitted with a diagnosis of traumatic spinal cord injury in 2012 and 2013. No patients were excluded from stroke and traumatic spinal cord injury groups.

We recorded the sex, age, diagnostic group, Functional Independence Measure (FIM) admission score, FIM discharge score, length of stay (LoS) in the IRF, place of discharge of each patient (eg, home, acute care, or subacute care), and calculated the FIM efficiency score (change in FIM/LoS) for each patient. The FIM is an instrument that has 18 items measuring mobility, participation in activities of daily living, ability to communicate, and cognitive function.[7] Each item is scored from 1 to 7, with 1 denoting that the patient cannot perform the task and 7 that the activity can be performed independently. The minimum score is 18 (complete dependence), and the maximum score is 126 (independent function). Thirteen items compose the motor FIM score: eating, grooming, bathing, dressing upper body, dressing lower body, toileting, bladder management, management of bowel, transfer to bed or wheelchair, transfer to toilet, tub transfer, walking (or wheelchair use), and climbing stairs. Five items – comprehension, expression, social interaction, problem solving, and memory – compose the cognitive FIM score.

We used a 1-way analysis of variance to evaluate differences between age and cancer type, age and diagnostic group, admission FIM score and cancer type, discharge FIM score and cancer type, change in FIM and cancer type, LoS and cancer type, and LoS and diagnostic group. The Pearson chi-square test was used to test the goodness of fit between the place of disposition and diagnostic group. The paired *t* test was used to evaluate the improvement in FIM of the patients who were in the cancer groups. The Tukey Simultaneous Tests for Differences of Means was used to compare the FIM efficiency scores of the groups. A 2-sample *t* test was used to evaluate the factors associated with the need for transfer from the IRF to the acute medical service.

TABLE 2 Comparing primary brain cancer with metastatic brain cancer functional outcomes in change of Functional Independence Measure

	n	Mean change in FIM	SD	SE mean	Diff of mean	95% CI	*P* value
Metastasis to brain	16	7.6	20.1	5.0	−11.81	(−22.23 to −0.39)	.043
Primary brain cancer	23	19.4	10.3	2.2			

95% CI, 95% confidence interval; Diff of Mean, difference of the means; FIM, Functional Independence Measure; SD, standard deviation; SE mean, standard error of mean

TABLE 3 Comparing stroke with combined primary and metastatic brain cancer in functional outcomes by change in Functional Independence Measure

	n	Mean change in FIM	SD	SE mean	Diff of mean	95% CI	*P* value
Primary and metastatic brain cancer	39	14.6	16.0	2.6	−9.8	(−15.81 to −3.85)	.002
Stroke	69	24.4	12.8	1.5			

95% CI, 95% confidence interval; Diff of mean, difference of the means; FIM, Functional Independence Measure; SD, standard deviation; SE Mean, standard error of mean

Results

The demographic characteristics of the patients in the study and the admission and discharge FIM scores are reported in Table 1. There were initially 62 cancer patients in the radiation group, which was further divided into 4 subgroups based on the site of the primary tumor or metastasis. In all, 23 had a primary malignant brain tumor and received radiation and temozolomide. Sixteen patients had malignancies metastatic to the brain, 15 patients had tumors metastatic to the spine, and 7 had tumors metastatic to the long bones. One patient had laryngeal cancer and was excluded from the study because we did not think that we could do an analysis of a group with only 1 patient. The final number of patients in the cancer group was therefore 61. There were 69 patients in the stroke group and 23 in the spinal cord injury group.

We report improvement in total FIM, motor FIM, and cognitive FIM scores and were able to identify all 18 of the items of the FIM score on 60 of the 61 patients in the cancer group. Improvement in total FIM of the 61 patients in the cancer groups was significant at $P < .001$, as was improvement in motor FIM at $P < .001$. Improvement in cognitive FIM was borderline significant at $P = .05$. Just over 75% of the patients in the cancer group had sufficient enough improvement in their level of function that they were able to return to their homes (Table 1). The average FIM score at the time of discharge was 83.08. This was not significantly different than the level of function of patients discharged after stroke (87.52) or traumatic spinal cord injury (89.13).

The patients with primary brain tumors were younger than the patients with cancer metastatic to the brain ($P = .013$). The patients with a primary brain tumor had lower admission FIM scores than patients with tumors metastatic to the brain ($P = .027$). The patients with a primary brain tumor had a greater increase in FIM score than patients with metastasis to the brain ($P = .043$; Table 2). There was not a significant difference between these 2 groups in FIM score at discharge or in the likelihood of discharge to home (Table 1). The FIM efficiency score was 1.12 for the patients in the primary brain tumor group and .80 in those with metastasis to the brain. This difference was not significant $P = .96$.

There were 69 patients in the stroke group. We compared the 39 patients with primary or metastatic brain lesion to the stroke group. The patients with primary or metastatic cancer of the brain were younger than the patients with stroke, 60.4 years old versus 69.1 years old ($P = .004$). The patients in the combined cancer group had a higher admission FIM score compared with the stroke patients (68.4 vs 63.12; $P = .05$). The discharge FIM scores were 83.3 in the combined cancer group and 87.5 in the stroke group (Table 1). This difference was not significant, but the improvement in the combined cancer group (14.6) was less than the improvement in the stroke group (24.40; $P = .002$) (Table 3).

The average LoS in the IRF was 18.7 days in the combined cancer group and 16.8 days in the stroke group. This difference was not significant. An average of 82% of the patients in the primary tumor or brain metastasis group and 85.5% of the patients in the stroke group were discharged to home. This difference was not significant. The FIM efficiency score of the patients in the stroke group was 2.0. This was significantly greater than the score for

TABLE 4 Comparing metastasis to spinal cord with spinal cord injury in functional outcomes by change in Functional Independence Measure

	n	Mean change in FIM	SD	SE mean	Diff of mean	95% CI	*P* value
Metastasis to spinal cord	15	13.9	12.2	3.2	−17.2	(−25.93 to −8.47)	<.001
SCI	23	31.1	13.9	2.9			

95% CI, 95% confidence interval; Diff of mean, difference of the means; FIM, Functional Independence Measure; SCI, spinal cord injury; SD, standard deviation; SE mean, standard error of mean

the patients in the metastasis to the brain group (0.80; P = .044) but not significantly greater than the primary brain cancer group (1.19; P = .22).

There were 23 patients in the traumatic spinal cord injury group. A comparison of the patients with tumors metastatic to the spine and patients with traumatic spinal cord injury showed that the patients in the cancer group were older (60.27 and 42.70 years, respectively; P = .001). In all, 80% of patients with tumors metastatic to the spine were men. This was not significantly different from the percentage of men in the traumatic spinal cord injury group (82.6%; Table 1). The admission FIM score of the patients with cancer was 66.5 (standard deviation [SD], 13.3) and 58.03 (SD, 15.1) in the patients with a traumatic spinal cord injury (Table 1). The FIM score at discharge was 80.4 (SD, 19.1) in the patients with cancer and 89.1 (SD, 20.3) in the patients with a traumatic spinal cord injury (Table 1). Neither of these were statistically significant. The improvement in patients with cancer was 13.9 (SD, 12.2) and 31.1 (SD, 13.9) in the traumatic spinal cord injured patients. This difference was significant (P < .001; Table 4). The median LoS was 18.98 days in the cancer metastasis to spine group (interquartile range [IQR] is the 25th-75th percentile, 12-30 days). In the traumatic group the median LoS was 23 days (IQR, 16-50 days). This difference was not significant (P = .14 Mann-Whitney test). The mean FIM efficiency score was 1.46 in the traumatic spinal cord injury group and .78 in the group with cancer metastatic to the spine. This difference was not significant (P = .72). Sixty percent of the patients in the cancer group were discharged to home, and 87% of patients in the traumatic spinal cord group were discharged to home. This difference was not significant (P = .12; Fisher exact test).

As far as we can ascertain, this is the first paper that has looked at the outcomes of patients receiving rehabilitation concurrent with radiation of the long bones. The average improvement in FIM was 12.4 (Table 1). The LoS was 11.6 days, and the FIM efficiency was 1.25. In all, 71.4% made enough progress to go home.

Of the total number of cancer patients, 18% were transferred to the acute medical service of the hospital (Table 1). Neither age, sex, type of cancer, nor admission FIM score were associated with the need for transfer to acute hospital care. Change in FIM score was inversely associated with transfer to acute hospital care (P = .027). Patients whose function did not improve with rehabilitation were most likely to be transferred back to acute hospital care.

Discussion

Radiation therapy is considered a service that is provided to people who come for treatment as an outpatient. Caregivers may have difficulty transporting patients to radiation if the patient has deficits in mobility. This may be particularly true if the patient is heavy, the caregivers are frail, or perhaps if they live in rural settings where there is no wheelchair-accessible public transportation. There are many factors that help determine whether a patient with functional deficits can be discharged to his or her home. These include sex, age, marital status, family and/or community support, income, and insurance.[8] The FIM is an instrument that indicates how much help a patient needs with mobility and self-care skills. It also correlates with the amount of time that caregivers must spend helping a patient.[9] Study findings have shown that the FIM score is an important determinant of whether a patient can be discharged to home. The total FIM score is as useful as an analysis of the components of the FIM score in predicting whether a patient can return to the community.[10,11] Reistetter and colleagues found a total FIM score of 78 to be the score that best separates patients who are likely to be able to go home and patients who are likely to need long-term care.[11] Bottemiller and colleagues[10] reported that 37% of patients with total discharge FIM scores of less than 40 were discharged to home. They reported that 62% of patients with FIM scores between 40 and 79 were discharged to home, and 88% of patients with scores of 80 or above were discharged to home.[10] The goal in bringing patients to the IRF was to accept and treat patients with reasonable community support and potential to achieve a functional level compatible with discharge to the community. Most patients in each of the cancer groups were able to reach an FIM score of 78 to 80 and to be discharged to home.

Most of the patients in the cancer groups had underlying problems that are not considered curable. The primary goal

was to enable the patients to have some time at home with their families before requiring readmission to a hospital or hospice care. Reasonable LoS and rate of progress are now expected or required by third-party payors and hospital administrators. Physicians at the Mayo Clinic have indicated that a rehabilitation service should aim for an FIM efficiency score of at least .6 points per day.[10] The FIM efficiency of patients in each of the 4 cancer subgroups in this study was higher than this level.

J. Herbert Dietz, Jr was an early advocate of the need to provide comprehensive rehabilitation services for patients with cancer. He first described his work in 1969.[12] Since that time, there have been many papers that have documented the benefits of IRF for patients with cancer. O'Toole and Golden have shown outcomes of a large series of patients from an IRF. They reported that at the time of admission, 14% of patients could ambulate, but at discharge, 80% could ambulate without hands-on assistance. They reported significant improvements in continence, FIM score, and score on the Karnofsky Performance Scale.[13] Marciniak,[14] Hunter,[15] Shin,[16] and Cole,[17] and their respective colleagues have all shown that patients with many different types of cancer benefit from rehabilitation at the IRF level. Gallegos-Kearin and colleagues[4] reported on the care of 115,570 patients admitted to IRF with cancer from 2002 to 2014. Patients had significant improvement in function, with more than 70% of patients discharged to home.[4] Ng and colleagues studied a group of 200 patients who received IRF care and found there was significant improvement in function. Ninety-four percent of patients rated their stay as either extremely good or very good.[5]

Metastasis to the spine is a common problem. It is found in 30% of cancer patients at autopsy. The most common sources of metastasis to the spine are breast, lung, prostate, kidney, and thyroid.[18] Multiple myeloma and lymphoma may also involve the spine. Several authors have shown that these patients benefit from inpatient rehabilitation. Mckinley and colleagues[19] have noted that patients with metastasis to the spine make significant improvement with care at an IRF. Compared with patients with a traumatic spinal cord injury, the cancer patients had shorter LoS, smaller improvement in FIM, equal FIM efficiency (FIM gain/LoS), and equal success in making enough progress to be discharged to home.[19] Eriks and colleagues showed that patients at an IRF in Amsterdam made significant improvement in function as measured by the Barthel's Index.[20] Tang .,[21] and Parsch[22] and their respective colleagues, Murray,[23] and New[24] and colleagues have published findings confirming that patients with spinal cord injury caused by metastasis to the spine make significant progress with inpatient rehabilitation programs. The present study adds to the literature by showing that patients with metastasis to the spine who are receiving radiation can make progress and be discharged to the community.

There are 24,000 new cases of primary malignant brain tumors in the United States each year.[25] The incidence of metastatic cancer to the brain has been estimated to be 100,000 cases per year in the United States. The most common cancer sources are lung, breast, melanoma, kidney, and colon.[26,27] The first study of patients admitted to an IRF for treatment of brain tumors was published in 1998 by Huang and colleagues[28] who compared the outcomes of 63 patients with brain tumors with the outcomes of 63 patients with stroke. They reported that the patients with the brain tumors made significant improvement in function. There was not a significant difference between the 2 groups of patients in improvement in function, FIM efficiency, or success in discharging the patients to home.[28] Greenberg[29] and Bartolo[30] and their respective colleagues compared the outcomes of patients admitted with brain tumors and patients with stroke and found that improvement in function and discharge to home was similar in the 2 groups. In 2000, Huang and his same colleagues[31] compared a group of patients with brain tumors to a group of patients with traumatic brain injury. They found significant improvement in the function of the patients with brain tumors. Patients in the traumatic brain injury group made more progress but had longer LoS. FIM efficiency was not significantly different between the groups.[31]

Three papers have reported outcomes of patients who received radiation concurrent with inpatient rehabilitation. Tang and colleagues[32] reported 63 patients, of whom 48% percent received radiation concurrent with rehabilitation. The patients who received radiation made significant gains in function, and more than 70% were discharged to home. There was no difference in the outcomes of the patients in the radiation and nonradiation groups.[32] Marciniak[33] and O'Dell[34] and their colleagues also reported that patients with brain tumors that required radiation therapy can benefit from inpatient rehabilitation. The present paper is the fourth (with the largest patient group) to show that patients with primary and metastatic tumors to the brain can benefit from a program that provides radiation concurrent with inpatient rehabilitation. We have shown that patients can achieve functional levels and rates of discharge to home that are not significantly different from those of the most commonly admitted group of patients to IRF – patients with stroke.

In the present study, 18% of all of the cancer patients were transferred to medical services and/or acute hospital care (Table 1). This is consistent with a paper by Asher and colleagues[35] who reported that 17.4% of patients at an IRF with a diagnosis of cancer required transfer back to medical service, and that low admission motor FIM score correlated with the likelihood of transfer back to medical service. In the present paper, the total admission FIM score was not related to the likelihood of return to medical ser-

vice, although a lack of improvement in the FIM score did correlate with transfer to medical service.

All of the papers we reviewed found that appropriately selected patients with cancer make significant improvement in function with treatment at an IRF. Tang and colleagues have also shown that for patients with malignant brain tumors and metastasis to the spine, improvement in function correlates with increased survival.[32] Our paper confirms that patients with primary malignant brain tumors, malignant tumors metastatic to the brain or spine, and tumors metastatic to long bones may benefit from rehabilitation concurrent with radiation. Rehabilitation units are traditionally associated with treating patients with stroke and spinal cord injury. The patients in our study had cancer and were receiving radiation therapy. They had significant improvement in function and FIM efficiency scores that are not below the threshold set as expected for care at an IRF. Most patients in our study achieved a functional level consistent with what is needed to go home.

There is a prospective payment or reimbursement system for rehabilitation units.[36] The payments are based on the admitting diagnosis, the admission FIM score, the age of the patient, and comorbidities. There are 4 tiers for comorbidities with no additional payments for patients in tier 0 but with additional payments for patients with conditions that qualify for tiers 1 through 3. The highest payments are for patients in tier 1. Examples of conditions that can increase payment include morbid obesity, congestive heart failure, vocal cord paralysis, and the need for hemodialysis. There is no increased payment for provision of radiation therapy. There are no reports on the feasibility, in terms of finances, of providing radiation on an IRF. We asked the finance office of the Albany Medical Center to comment on the cost to the hospital of providing radiation therapy to patients on the rehabilitation unit. The hospital's finance department reviewed available data and reported that the variable cost of providing radiation therapy is about 6.5% of the revenue collected from third-party payors for caring for patients who receive that service (personal communication from the finance office of Albany Medical Center to George Forrest, 2015). Our findings suggest that the Centers for Medicare & Medicaid Services should make an adjustment to the payment system to support the cost of providing radiation to patients at an IRF. Even under the current payment system, for a hospital that has the equipment and personnel to provide radiation treatments, the variable cost of 6.5% of revenue should not be an absolute barrier to providing this service.

Limitations

This study reports on the experience of only 1 facility. The number of patients in the radiation group is greater than the number of patients in any previous report of people receiving radiation at an IRF, but the statistician does not think it is large enough to allow statistical analysis of covariates such as age, sex, and comorbid conditions. In addition, we did not investigate all of the factors that influence the type of care patients are offered and their LoS, such as hospital policy, insurance coverage, income, and family structure.

Conclusions

Acute care medical units are now challenged to both reduce LoS and reduce the number of patients who are readmitted to the hospital. Rehabilitation units are challenged to maintain census, as government and private payors are shifting patients from acute rehabilitation units to subacute rehabilitation units. We found that patients with cancer who need radiation are a population of patients who are seen by payors as needing to be in a facility with excellent nursing, therapy, and comprehensive physician services. A comprehensive cancer care program within a rehabilitation unit can be a great benefit to the acute care services, the IRF, and, most importantly, patients and their families.

References

1. American Cancer Society. Cancer facts & figures 2016. Atlanta, GA: American Cancer Society; 2016.
2. National Cancer Institute: Office of cancer survivorship: statistics. https://cancercontrol.cancer.gov/ocs/statistics/statistics.html. Updated October 17, 2016. Accessed April 21, 2018.
3. Lehmann JF, DeLisa JA, Warren CG, deLateur BJ, Bryant PL, Nicholson CG. Cancer rehabilitation: assessment of need, development and evaluation of a model of care. Arch Phys Med Rehabil. 1978;59(9):410-419.
4. Gallegos-Kearin V, Knowlton SE, Goldstein R, et al. Outcome trends of adult cancer patients receiving inpatient rehabilitation: a 13-year review [published online Feb 21, 2018]. Am J Phys Med Rehabil. doi:10.1097/PHM.0000000000000911
5. Ng AH, Gupta E, Fontillas RC, et al. Patient-reported usefulness of acute cancer rehabilitation. PM R. 2017;9(11):1135-1143.
6. Cheville AL, Kornblith AB, Basford JR. An examination of the causes for the underutilization of rehabilitation services among people with advanced cancer. Am J Phys Med Rehabil. 2011;90(5 suppl 1):S27-S37.
7. Cohen ME, Marino RJ. The tools of disability outcomes research functional status measures. Arch Phys Med Rehabil. 2000;81(12 suppl 2):S21-S29.
8. Nguyen VQ, PrvuBettger J, Guerrier T, et al. Factors associated with discharge to home versus discharge to institutional care after inpatient stroke rehabilitation. Arch Phys Med Rehabil. 2015;96(7):1297-1303.
9. Forrest G, Schwam A, Cohen E. Time of care required by patients discharged from a rehabilitation unit. Am J Phys Med Rehabil. 2002;81(1):57-62.
10. Bottemiller KL, Bieber PL, Basford JR, Harris M. FIM scores, FIM efficiency and discharge following inpatient stroke rehabilitation. Rehabil Nurs. 2006;31(1):22-25.
11. Reistetter TA, Graham JE, Deutsch A, Granger CV, Markello S, Ottenbacher KJ. Utility of functional status for classifying community versus institutional discharges after inpatient rehabilitation for stroke. Arch Phys Med Rehabil. 2010;91(3):345-350.
12. Dietz JH Jr. Rehabilitation of the cancer patient. Med Clin North Am. 1969;53(3):607-624.

13. O'Toole DM, Golden AM. Evaluating cancer patients for rehabilitation potential. West J Med. 1991;155(4):384-387.
14. Marciniak CM, Sliwa JA, Spill G, Heinemann AW, Semik PE. Functional outcome following rehabilitation of the cancer patient. Arch Phys Med Rehabil. 1996;77(1):54-57.
15. Hunter EG, Baltisberger J. Functional outcomes by age for inpatient cancer rehabilitation: a retrospective chart review. J Appl Gerontol. 2013;32(4):443-456.
16. Shin KY, Guo Y, Konzen B, Fu J, Yadav R, Bruera E. Inpatient cancer rehabilitation: the experience of a national comprehensive cancer center. Am J Phys Med Rehabil. 2011;90(5 suppl 1):S63-S68.
17. Cole RP, Scialla S, Bednarz L. Functional recovery in cancer rehabilitation. Arch Phys Med Rehabil. 2000;81(5):623-627.
18. White AP, Kwon BK, Lindskog DM, Friedlaender GE, Grauer JN. Metastatic disease of the spine. J Am Acad Orthop Surg. 2006;14(11):587-598.
19. McKinley WO, Huang ME, Tewksbury MA. Neoplastic vs traumatic spinal cord injury: an inpatient rehabilitation comparison. Am J Phys Med Rehabil. 2000;79(2):138-144.
20. Eriks IE, Angenot EL, Lankhorst GJ. Epidural metastatic spinal cord compression: functional outcome and survival after inpatient rehabilitation. Spinal Cord. 2004;42(4):235-239.
21. Tang V, Harvey D, Park Dorsay J, Jiang S, Rathbone MP. Prognostic indicators in metastatic spinal cord compression: using functional independence measure and Tokuhashi scale to optimize rehabilitation planning. Spinal Cord. 2007;45(10):671-677.
22. Parsch D, Mikut R, Abel R. Postacute management of patients with spinal cord injury due to metastatic tumor disease: survival and efficacy of rehabilitation. Spinal Cord. 2003;41:205-210.
23. Murray PK. Functional outcome and survival in spinal cord injury secondary to neoplasia. Cancer. 1985;55:197-201.
24. New PW. Functional outcomes and disability after nontraumatic spinal cord injury rehabilitation: results from a retrospective study. Arch Phys Med Rehabil. 2005;86(2):250-261
25. Central Brain Tumor Registry of the United States: 2016 CBTRUS fact sheet. www.cbtrus.org/factsheet/factsheet.html. Updated 2017. Accessed May 28, 2016.
26. Memorial Sloan Kettering Cancer Center: Metastatic brain tumors & secondary brain cancer. https://www.mskcc.org/cancer-care/types/brain-tumors-metastatic. Updated 2018. Accessed April 21, 2018.
27. Bruckner JC, Brown PD, O'Neill BP, Meyer FB, Wetmore CJ, Uhm JH. Central nervous system tumors. Mayo Clin Proc. 2007;82(10):1271-1286.
28. Huang ME, Cifu DX, Keyser-Marcus L. Functional outcome after brain tumor and acute stroke: a comparative analysis. Arch Phys Med Rehabil. 1998;79(11):1386-1390.
29. Greenberg E, Treger I, Ring H. Rehabilitation outcomes in patients with brain tumors and acute stroke: comparative study of inpatient rehabilitation. Am J Phys Med Rehabil. 2006;85(7):568-573.
30. Bartolo M, Zucchella C, Pace A, et al. Early rehabilitation after surgery improves functional outcomes in inpatients with brain tumours. J Neurooncol. 2012;107(3);537-544.
31. Huang ME, Cifu DX, Keyser-Marcus L. Functional outcomes in patients with brain tumor after inpatient rehabilitation: comparison with traumatic brain injury. Am J Phys Med Rehabil. 2000;79(4):327-335.
32. Tang V, Rathbone M, Park Dorsay J, Jiang S, Harvey D. Rehabilitation in primary and metastatic brain tumours: impact of functional outcomes on survival. J Neurol. 2008;255(6):820-827.
33. Marciniak CM, Sliwa JA, Heinemann AW, Semik PE. Functional outcomes of persons with brain tumors after inpatient rehabilitation. Arch Phys Med Rehabil. 2001;82(4):457-463.
34. O'Dell MW, Barr K, Spanier D, Warnick RE. Functional outcome of inpatient rehabilitation in persons with brain tumors. Arch Phys Med Rehabil. 1998;79(12):1530-1534.
35. Asher A, Roberts PS, Bresee C, Zabel G, Riggs RV, Rogatko A. Transferring inpatient rehabilitation facility cancer patients back to acute care (TRIPBAC). PM R. 2014;6(9):808-813.
36. Centers for Medicare and Medicaid Services: Inpatient rehabilitation facilities. https://www.cms.gov/Medicare/Provider-Enrollment-and-Certification/CertificationandComplianc/InpatientRehab.html. Published March 5, 2012. Accessed May 21, 2018.