

Cost and Return on Investment of a Team-Based Palliative Care Program for Parkinson Disease

Robert Brett McQueen, PhD, Mark Gritz, PhD, Drew Kern, MD, Julianne L. Bemski, DO, Ian Shelton, BA, Martha Meyer, PhD, and Benzi M. Kluger, MD, MS

Correspondence

Dr. McQueen
robert.mcqueen@cuanschutz.edu

Neurology: Clinical Practice December 2022 vol. 12 no. 6 429-437 doi:10.1212/CPJ.000000000200103

Abstract

Implementation of palliative care (PC) in neurology settings may improve symptom control and quality of life and reduce acute care admissions. The benefits of team-based PC for patients with Parkinson disease have been established through rigorous evidence standards including randomized controlled trials. However, evidence on implementation costs and return on investment (ROI) is unknown and may guide other providers and systems considering this model of care. We applied time-driven activity-based costing with reimbursable visits calculated using Medicare reimbursement rates in Colorado and current procedural technology codes to 2 outpatient clinics at the University of Colorado Hospital: neurology PC and movement disorders. Per-patient ROI was calculated as the ratio of the incremental difference in financial revenues divided by the incremental difference in investment to expand PC services. The cost per new patient was \$154 and \$98 for neuropalliative and movement disorders clinics, respectively. Established patient visit costs were \$82 and \$41 for the neuropalliative care and movement disorders clinics, respectively. The neurology PC clinic had per-patient revenue for new and established visits of \$297 and \$147, respectively, compared with \$203 and \$141 for new and established visits, respectively, at the comparator clinic. Based on our assumptions, for every \$1 invested in expanding PC services, a projected \$1.68 will be recouped by the hospital system for new patient visits, and \$0.13 will be recouped for established patient visits. These amounts are context dependent, and a calculator was created to allow other systems to estimate costs and ROI. Our results suggest that in an academic medical setting, both neurology PC and movement disorders clinics provided increased revenue to the health system. Opportunities to improve ROI include efficient allocation of personnel to new and established visits, expanding telemedicine, and other cost offsets for complex patients not estimated in this analysis. ROI may also be greater in health systems that benefit from cost savings such as accountable care organizations. Our approach may be applied to other novel care models. Future research efforts will focus on estimating the continued sustainability of this innovative outpatient care model.



RELATED ARTICLES

Editorial

Neurologists and Palliative Care: Are We Doing Enough?

Page 386

Research Article

Health Care Utilization in the Last Year of Life in Parkinson Disease and Other Neurodegenerative Movement Disorders

Page 388

In the United States, more than 50% of all health care costs are attributable to 15% of individuals with life-limiting conditions and functional limitations.¹ The disproportionately higher costs in this population reflect the complexity of care, with many patients forced to rely

Skaggs School of Pharmacy and Pharmaceutical Sciences (RBM), University of Colorado Anschutz Medical Campus, Aurora; Department of Health Care Policy and Research (MG, MM), University of Colorado Anschutz Medical Campus, Aurora; Departments of Neurology and Neurosurgery (DK), University of Colorado Anschutz Medical Campus, Aurora; Swedish Medical Center (JLB), Family Residency Program, Denver, CO; Pharmacology Graduate Program (IS), University of Colorado Anschutz Medical Campus, Aurora; and Departments of Neurology and Medicine (BMK), University of Rochester Medical Center, NY.

Funding information and disclosures are provided at the end of the article. Full disclosure form information provided by the authors is available with the full text of this article at [Neurology.org/cp](https://www.neurology.org/cp).

The Article Processing Charge was funded by the authors.

This is an open access article distributed under the terms of the Creative Commons Attribution-NonCommercial-NoDerivatives License 4.0 (CC BY-NC-ND), which permits downloading and sharing the work provided it is properly cited. The work cannot be changed in any way or used commercially without permission from the journal.

on acute hospital care given a lack of alternative options.¹⁻⁵ In response to poor health outcomes and inefficient care for patients with life-limiting conditions, there is broad support to invest in innovative and sustainable care models.⁶⁻⁹

Palliative care (PC) improves symptom control, quality of life, and coordination of complex care for patients with life-limiting conditions.^{2,4,10-12} Evidence suggests strong benefits when involving interdisciplinary PC teams early in the course of illness.^{13,14} Notably, a small group of academic centers now offer interdisciplinary outpatient PC for patients and caregivers with neurologic disorders such as Parkinson disease (PD), and there is mounting evidence of benefit including randomized controlled trials.^{14,15} Evidence of implementation costs, cost-effectiveness, and return on investment (ROI) potential may aid health care systems considering interdisciplinary PC models of care for PD and other neurologic conditions.

Previous evidence on costs, cost-effectiveness, and ROI from expanding PC services is mixed and depends on the setting (i.e., hospital based, outpatient, and home based), timing of interventions, outcomes measured, and payment models, among other factors.^{11-13,16-24} Specific challenges include measuring all costs and outcomes from expanding PC services to establish the link between resources expended and the full patient care cycle.^{25,26} Although billing and reimbursement data are available from provider financial systems, a methodologic challenge is to accurately estimate how much services actually cost to the provider.²⁷ Billed and reimbursed services are not necessarily reflective of what a particular service costs in terms of the utilization of resources and the unit prices of those resources. In competitive reimbursement environments, providers and health policy initiatives are searching for accurate cost measurement solutions capable of informing value-based health care calculations.²⁸

One novel approach that has recently been adopted in health care is time-driven activity-based costing (TDABC). TDABC is a costing approach that engages clinical and financial teams to accurately estimate resources and costs involved to treat patients over their care cycle.^{26,29} Organizations can use TDABC to understand the costs of generating health outcomes regardless of location (i.e., inpatient, outpatient, and home based). TDABC is estimated using the unit price for providing a service and how much time is involved in providing that service. Knowing the time and price involved in providing care, TDABC can then be used to inform costs used in cost-effectiveness analyses and opportunities for reimbursement in various payment models to ensure sustainability from a health system perspective.^{25,28,30,31} However, the use of TDABC in neurologic conditions is limited.³¹

Given emerging evidence on the clinical benefits of interdisciplinary outpatient PC services and a lack of cost and ROI evidence, we applied TDABC to an academic outpatient setting

at the University of Colorado Hospital (UCH) to estimate relative costs for expansion and sustainability scenarios. Specifically, the goal of this project was to estimate the incremental costs and opportunities for ROI of UCH neurology PC clinic compared with a neurology clinic without PC services.

Methods

Setting

This study was performed within the UCH outpatient neurology clinics for PC and movement disorders. Data for PC clinics were derived from outpatient interdisciplinary PC clinics from July 2017 to June 2018. The UCH neuropalliative care clinics follow an embedded and integrated model of PC where clinics are colocated with other neurology services and led by 2 neurologists with additional expertise in PC and an interdisciplinary team including a nurse, physician assistant, social worker, and chaplain. Patients and their family care partners will typically see all members of the team on new visits following a standard checklist and may see fewer team members on follow-up visits depending on their ongoing issues. Patients are referred based on needs perceived by referring clinicians or patients/families (e.g., difficulty coping with diagnosis, chronic pain, caregiver distress, and assistance with defining goals of care) rather than strictly defined stages or prognosis, although the majority of patients do have advanced PD or related disorders, often with dementia.³² This clinic was subsequently compared with the UCH movement disorders clinic, which consisted of a physician, physician assistant, and access to a nurse. We included patients with PD or related disorders from both clinics. The analyses are from a provider or hospital system perspective with a 1-year time horizon.

Time-Driven Activity-Based Costing

We used components of the TDABC method to estimate the cost of implementing the neurology PC outpatient clinic compared with movement disorders clinic that has fewer resources and available patient care time. TDABC estimates cost using the unit cost of resource inputs (labor and non-labor) and the time and quantity of resources used to perform an activity.^{25,26,29,33} First, we developed a process map to detail administrative and clinical processes involved in treating patients with PD with PC needs. Second, we directly observed the proportion of visits spent with patients by providers and the time spent to treat patients with PD for each provider over the course of 5 clinic days. To expand beyond our observation period, we used administrative and financial data to identify the number of visits per year stratified by new and established patient visits (July 2017–June 2018). In addition, we estimated the proportion of visits by level of complexity for the neurology PC outpatient and comparator clinics. Third, we contacted financial teams to identify salary, benefit, and full-time equivalent (FTE) information for each provider in the neurology PC and movement disorders clinics. We use FTE information to identify how much clinic time providers were spending in each clinic; however, the final calculations depend on the

Table 1 Annual Visit and Clinic Characteristics for Neuropalliative Care and Comparator Clinics

Category	Subcategory	Neuropalliative care	Comparator
Visit characteristics			
	Mean number of visits per day (95% CI)	26 (21–30)	Assumed same as neuropalliative care
	Mean new patient visits per day (95% CI)	7 (6–9)	
	Mean established patient visits per day (95% CI)	19 (16–22)	
	Mean number of visits per year at 50 clinic days per year (95% CI)	1,300 (1,050–1,500)	
Proportion of office visits by level (average of new and established)			
	1	0%	0%
	2	0%	1%
	3	1%	2%
	4	4%	15%
	5	95%	82%
Space characteristics			
	Square footage of clinic	1,123	Assumed half the space as neuropalliative care
	Number of examination rooms actively used each clinic day	8 rooms and 1 command center room	

total sum of salary plus benefits paid for clinical time. Where salary information was not available, we used national US pay and benefit information from the Bureau of Labor Statistics.³⁴ Finally, we calculated the total direct costs of all the resources used for each patient visit and validated our numbers with providers. Our calculation includes the total square footage required to run the clinic. We used market research on occupancy costs by region to estimate a cost per square foot, which then was translated into a cost per patient based on the annual occupancy costs and total patient visit count for the year.³⁵ We assumed the same number of visits and the same size clinic to isolate the ROI of the care model being evaluated. In other words, revenue or costs were not driven by factors unrelated to the neuro-PC model.

The calculation of total per-patient cost was as follows:

Per-patient cost = minutes spent with each provider × proportion of visits seen by a provider × the unit cost per minute and summed across all providers for each clinic type.

Where unit cost per minute = total salary + benefits / (2080 working hours × 60 minutes).

Resources devoted to research were removed from the cost estimation. We did not exclude patient visits based on the characteristics of patients seen at either clinic. All costs are in 2018 US dollars.

Financial Revenues and ROI

Similar to the TDABC methods, we used a time-driven medical visit reimbursement approach to calculate financial revenues from both new and established visits. Each reimbursable visit was calculated using a weighted average of Medicare reimbursement rates in Colorado and the proportion of patient visits by current procedural technology codes (e.g., 99204 and 99205) as shown in Table 1. Additional opportunities for financial revenue included advanced care planning (i.e., 99497) for all new patient visits.

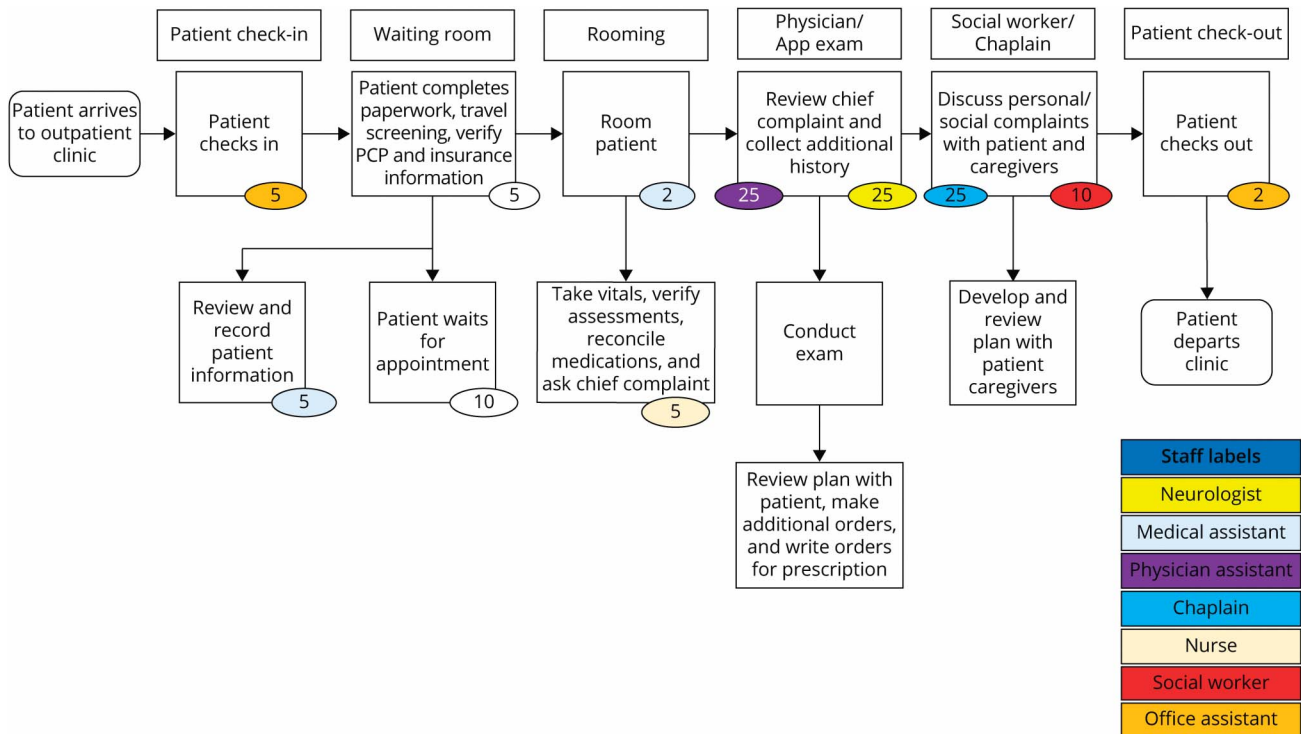
We used the following formula to calculate per-patient visit reimbursement for new and established visits separately:

Per-patient visit reimbursement = Medicare allowable payment × proportion of visits by procedure codes.

Where Medicare allowable payment is a function of total RVUs with the appropriate Medicare conversion factor applied.

Per-patient visit ROI was calculated as the ratio of the incremental difference in financial revenues divided by the incremental difference in investment made by UCH for each patient visit. When ROI is greater than 1, the returns generated by the additional investment actions are greater than the costs of the investment and are considered positive revenue to the system. When the ROI is less than 1, the returns generated by the additional investment yield a net loss and

Figure 1 Outpatient Neurology Palliative Care Process Map for Established Patient Visits



The process map details the flow for an average established patient visiting the neurology PC outpatient clinic. The process map documents each activity (rectangles), the personnel type assigned to the activity (color codes), and the average time to complete the activity in minutes (circles). The top row of rectangles is an example of the complete cycle of care of a patient with PD through the University of Colorado neurology PC clinic. The middle boxes detail the specifics of each patient interaction and include small circles to indicate the number of minutes spent with each patient. The color within each bubble indicates the time spent with each provider. Within each activity, patients may see both or only one of the providers listed in the activity box. PC = palliative care; PD = Parkinson disease.

are considered negative to the system. Our calculations are available in a user-friendly Excel spreadsheet to tailor cost and expected revenue to other care settings, health care systems, and patient populations (contact the corresponding author to access the spreadsheet). Further details of our calculations can be found in the technical appendix (eAppendix 1, <http://links.lww.com/CPJ/A384>).

Given the uncertainty in our results compared with other clinic settings, we provide targeted sensitivity and scenario analyses to inform readers on the most influential inputs on our outcome of incremental ROI. The sensitivity and scenario analyses hold the comparator arm fixed and only vary the neuro-PC inputs. The scenarios include altering reimbursement rates for advanced care planning, physician time spent with patients, proportion of visits providers spent with patients, proportion of visits by severity level, and space costs. This project was deemed IRB exempt as quality improvement by the Colorado Multiple Institutional Review Board.

Results

The process map details the flow for an average established patient visiting the neurology PC outpatient clinic (Figure). The process map documents the personnel and average time

spent with each patient recorded at the neurology PC outpatient clinic. For example, after checking in and rooming each patient, the average established patient spends 25 minutes with a physician or physician assistant, 10 minutes with a social worker, and 25 minutes with a chaplain. We linked the process map with administrative and financial data from the University of Colorado to calculate average production costs that inform implementation of neurology PC services into ambulatory settings not currently offering PC services. Table 1 details the visit characteristics, proportion of visits by level of complexity, and space characteristics. On average, the number of visits per day over a 1-year period was 26 (95% CI: 21–30), with 19 (95% CI: 16–22) as established visits and 7 (95% CI: 6–9) as new patient visits. The clinic operated on a weekly basis over the course of 50 weeks for an annual number of clinic days of 50 and visits totaling to approximately 1,300 from July 2017 to June 2018. The proportion of new and established patient visits for levels 3 and above was similar between the neurology PC and movement disorders clinic in terms of total percentages. However, we did observe a higher proportion of level 5 visits in the neurology PC outpatient clinic for patients with PD.

Visit time costs were estimated using the data collection on minutes per provider, the proportion of provider interaction

Table 2 Provider Time Costs and Interaction With Patients

Provider ^a	Neuropalliative care			Comparator		
	Minutes ^a	\$/min/FTE	Proportion of visits provider interacted with patient ^a	Minutes	\$/min/FTE ^b	Proportion of visits provider interacted with patient ^a
New patient visit						
Medical assistant	5	\$0.26 (1 FTE)	100%	5	\$0.26 (1 FTE)	100%
Registered nurse	10	\$0.56 (1 FTE)	75%	5	\$0.56 (1 FTE)	15%
Physician	50	\$1.72 (0.8 FTE)	100%	45	\$1.72 (1 FTE)	100%
Physician assistant	0	\$0.99 (0.8 FTE)	0%	0	\$0.99 (0.8 FTE)	0%
Social worker	30	\$0.29 (0.43 FTE)	100%	—	—	—
Chaplain	45	\$0.42 (1 FTE)	85%	—	—	—
Established patient visit						
Medical assistant	5	\$0.26 (1 FTE)	100%	5	\$0.26 (1 FTE)	100%
Registered nurse	5	\$0.56 (1 FTE)	30%	5	\$0.56 (1 FTE)	15%
Physician	25	\$1.72 (0.8 FTE)	50%	15	\$1.72 (1 FTE)	50%
Physician assistant	25	\$0.99 (0.8 FTE)	50%	15	\$0.99 (0.8 FTE)	50%
Social worker	10	\$0.29 (0.43 FTE)	55%	—	—	—
Chaplain	25	\$0.42 (1 FTE)	70%	—	—	—

Abbreviation: FTE = full-time equivalent.

^a Not every provider saw patients for each patient visit; proportion of visits further indicates how often each provider saw "patients" instead of "indications."

^b Although FTE is presented, we relied on total salary and benefits directly from the Department of Neurology at University of Colorado Hospital.

with patients on each visit, and the salary per minute per FTE across providers (Table 2). The primary driver of cost between the neurology PC clinic and the comparator clinic was the time spent with each provider and the number of providers. For example, the neurologist spent more time with the patient in both the new and established patient visits. As expected, the number of providers in the neurology PC clinic exceeded the number of providers in the movement disorders clinic through the use of a social worker and chaplain. The additional time and number of providers resulted in a time and space cost per visit of \$154 and \$82 for new and established visits, respectively, at the neurology PC clinic (Table 3). In contrast, the movement disorders clinic visit time cost was \$98 and \$41 for new and established visits, respectively. Extrapolating time costs over 50 clinic days per year, the total costs of new and established patient visits, including space costs, were approximately \$125,000 for the neurology PC clinic compared with approximately \$90,000 for the movement disorders clinic for an incremental cost difference of approximately \$35,000.

Financial revenue and ROI were calculated based on the Medicare reimbursement rate and the proportion of visits by each code (Table 3). The neurology PC and comparator clinics had new per-patient visit revenue that exceeded per-patient visit costs by \$143 and \$105 per patient visit,

respectively. The neurology PC and comparator clinics had established per-patient visit revenue that exceeded per-patient visit costs by \$65 and \$100 per patient visit, respectively. Small differences for reimbursement between clinics were a function of billing for advanced care planning for an incremental revenue difference between clinics of \$94 and \$6 per new and established patient visits, respectively. Extrapolating revenue over 50 clinic days per year, the total revenue of new and established patient visits was approximately \$250,000 for the neurology PC clinic compared with approximately \$210,000 for the movement disorders for an incremental added revenue of approximately \$40,000 (not shown in tables). ROI at the patient level for new and established patient visits was \$1.68 and \$0.13, respectively. In other words, for every \$1 invested in the neurology PC clinic, \$1.68 cents will be recouped by the hospital system for new patient visits, and \$0.13 will be recouped for established patient visits.

The results of the targeted sensitivity and scenario analyses (Table 4) found that key drivers of incremental ROI include reimbursement for advanced care planning with a reduced ROI to 0.51, assuming a 25% reimbursement rate; less physician time spent with patients, which improved ROI to 7.19 when a physician spends 25 minutes with a patient instead of 50 minutes; and space costs, which improved ROI

Table 3 Per-Patient Visit Time Costs, Financial Revenues, and Return on Investment

	Neuropalliative care	Comparator	Incremental
Time cost per patient visit			
New patients only	\$154	\$98	\$56
Established patients only	\$82	\$41	\$41
Reimbursement per patient visit			
New patients only	\$297	\$203	\$94
Established patients only	\$147	\$141	\$6
Projected return on investment for new patient visits (incremental revenue/incremental cost)	-	-	1.68
Projected return on investment for established patient visits (incremental revenue/incremental cost)			0.13

to 2.53 for new visits and 0.24 for established visits when assuming the same space as comparator clinic. These inputs influence the incremental ROI calculation, but must be interpreted in context to patient care. We provide all calculations in the technical appendix, and interested readers can request the ROI tool from the corresponding author to plug in clinic- and setting-specific inputs.

Discussion

This cost and ROI analysis highlights the importance of assessing and managing the sustainability of health care delivery by estimating costs at the patient level. Often, cost analyses performed by health systems or researchers use dollar amounts charged for medical services, which is not an accurate representation of the true cost of providing the services.^{26,29} The full cycle of care can include treating patients with multiple specialties, not all of whom are reflected in charges, such as through the neurology PC clinic. Our results suggest that neurology services with and without additional PC services generate positive revenue. However, the most sustainable use of resources may be efficient allocation of FTE based on new vs established visits.

A recent comprehensive review on the value of PC services suggests that both home-based and hospital-based interventions were cost-effective.²⁴ Specifically, home-based PC reduced aggressive treatments at the end of life, which improved quality of life and reduced utilization. Hospital-based PC was associated with reduced admissions and associated

costs. However, many of those studies in the hospital setting were specific to patients with cancer at the end of life. The review found mixed evidence for other approaches. Furthermore, results suggested a need for greater consistency in costs and outcome measures reported, among other pragmatic issues. Our study contributes to this body of literature by providing resources and potential reimbursement scenarios that are practical for neurologists to implement in their own settings.

Our results suggest a positive ROI when seeing new patients with expansion of PC services while the negative ROI corresponds to established visits. It is important to note that both clinics are revenue positive; therefore, additional PC services offered will not lose money from a health provider perspective, at least in this model system. Given that expansion of PC services to neurology clinics will be revenue positive, there are multiple opportunities to improve ROI. First, expansion of PC services may be allocated most efficiently for new patient starts, with existing patients requesting PC services during established visits on an as-needed basis. For established patients, based on the complexity of their care, we have found that only certain patients require a full team approach, and many can be managed by an APP with occasional consults from other team members. There are further opportunities to shift these health care provider meetings to a telemedicine format, which would free up space in the clinic for additional patient visits. Moreover, the clinics included in this analysis are housed at an academic medical center with a complex set of patients increasing the time spent with patients for each visit. The opportunity to improve ROI may be targeted differently for community settings vs academic medical centers. Our online calculator provides users the ability to increase or decrease personnel time by provider to efficiently allocate time and maximize reimbursement based on the complexity of their patient population.

To demonstrate some opportunities to improve ROI, we provided sensitivity and scenario analyses on key inputs based on the expert opinion of providers. Influential inputs included reimbursement for advanced care planning, physician time spent with patients during new visits, and space costs. Other inputs with less influence on incremental ROI included visits by severity level and proportion of visits seen by a particular provider. These results suggest that providers have multiple opportunities to improve ROI without sacrificing patient health outcomes. However, these analyses should be interpreted with caution, and we encourage others to plug in their own inputs for clinic-specific ROI calculations.

Second, there may be other opportunities for cost savings that are not included in our analysis and may further improve the ROI for established patient visits specifically. Evidence from multiple studies suggests that PC services provide significant cost savings to the health system from avoiding

Table 4 Sensitivity and Scenario Analyses

Input	Base input	Sensitivity analyses	Incremental ROI (new visit) [1.68 base value]	Incremental ROI (established visit) [0.13 base value]
Reimbursement rate for advanced care planning (new visits only)	100%	25%	0.51	N/A
		50%	0.9	N/A
Physician time spent with patients (new visits only)	50 min	25 min	7.19	N/A
		60 min	1.29	N/A
Proportion of visits spent with a physician assistant (established visits only)	50% with a physician and 50% with a physician assistant	25% with a physician/ 75% with a physician assistant	N/A	0.14
Proportion of office visits by level (average of new and established)	See Table 1	Neuropalliative care set to comparator	1.56	0.0
		100% level 5 visits	1.74	0.2
Space costs	Comparator assumed half size	Set equal to comparator	2.53	0.24

Abbreviation: ROI = return on investment.

^a All inputs changes were applied to the neuropalliative care arm while fixing the comparator arm.

hospitalizations and other costly care.^{11,13,19,22} For established patients in particular, this may result in cost offsets to other types of patient visits and may have benefits in terms of cost-sharing models (e.g., accountable care organizations) or access (e.g., increased inpatient beds).

Finally, PC services may have a different ROI depending on the payment system.¹⁷ Given efforts to shift payment models from volume- to value-based payment systems, outpatient PC services may move from an optional addition to a necessary addition to manage potentially high-cost patients. In addition, changes in reimbursement (e.g., Centers for Medicare & Medicaid Services revisions in evaluation and management coding) may also change, and potentially improve, ROI. Our online calculator is adaptable and may be useful to address both cost and reimbursement issues that providers may face under a value-based payment system.

There are important additional limitations that may affect our findings. Our analysis reflects sustainability to the health system, not societal value, which may include improvements to quality of life and symptom burden to patients and caregivers. In other words, value does not equate to reimbursement alone; rather, value is defined as outcomes relative to costs.²⁷ Outcomes vary dramatically across patient populations and recent research ROI evidence in other areas of neurology have defined additional outcomes not included here.^{36,37} For example, prior research has estimated a social ROI analysis (SROI) that includes peer support among patients with dementia. SROI makes use of financial proxies to establish the value of themes, such as reductions in loneliness and isolation, to estimate a market price for improving these themes where no market exists.³⁶ The study found a positive

SROI, suggesting that peer groups for people with dementia produce a greater SROI than the investment cost. Many themes from this research overlap with patients with PD and their caregivers needing further PC services. Given the positive clinical trial evidence on health outcomes,¹⁴ an SROI analysis would improve the ROI estimate found here. Moreover, other analyses are available to estimate the value of PC services, including cost-effectiveness analysis. Cost-effectiveness analyses have largely been performed on pharmaceutical interventions; however, value-based analyses are relevant to health services, which account for the majority of health care spending in the United States. Our research team has plans to expand to a cost-effectiveness analysis to estimate a societal value of expanding PC services. This could also include doing more specific comparisons in this and other neuropalliative care clinics, for example, with matching by diagnosis and comparing with other subspecialty and team-based clinics (e.g., progressive supranuclear palsy and amyotrophic lateral sclerosis). In addition, time horizon may affect the ROI over time. Specifically, there was a ramp-up period of referring patients to the clinic. Some of these patients may have been more complex than others, requiring additional average time with patients, which may be reduced in the future with a diverse mix of patients.

Despite these limitations, findings will inform other outpatient settings across the United States on the cost of expanding neurology clinics to include PC services. In addition, these findings will inform future efforts to estimate the societal cost-effectiveness of neurology PC to patients and caregivers by combining the time-cost information with effectiveness from trial-based results, and these methodologies could be applied to other novel clinic models. Our results suggest that in an academic medical setting, both neurology

PC and movement disorders clinics provided increased revenue to the health system. Implications of these findings can inform efficient and sustainable clinic implementation for PC services. Future research should focus on opportunities to improve ROI including efficient allocation of personnel to new and established visits, expanding telemedicine, and other cost offsets for complex patients not estimated in this analysis.

Study Funding

This project was funded by the Data Science to Patient Value (D2V) initiative at the University of Colorado Anschutz Medical Campus.

Disclosure

There are no conflicts of interest to report. The authors disclose funding for this study from the University of Colorado Data Science to Patient Value initiative. B.M. Kluger discloses financial support from the Patient-Centered Outcomes Research Institute (IHS-1408-20134) for unrelated work not involving the study design, collection of data, writing of the manuscript, or decision to submit the article for publication. Full disclosure form information provided by the authors is available with the full text of this article at Neurology.org/cp.

Publication History

Received by *Neurology: Clinical Practice* December 14, 2022. Accepted in final form September 8, 2022. Submitted and externally peer reviewed. The handling editor was Associate Editor John P. Ney, MD, MPH.

Appendix Authors

Name	Location	Contribution
Robert Brett McQueen, PhD	Skaggs School of Pharmacy and Pharmaceutical Sciences, University of Colorado Anschutz Medical Campus, Aurora, CO	Drafting/revision of the manuscript for content, including medical writing for content; major role in the acquisition of data; study concept or design; Analysis or interpretation of data
Mark Gritz, PhD	Department of Health Care Policy and Research, University of Colorado Anschutz Medical Campus, Aurora, CO	Drafting/revision of the manuscript for content, including medical writing for content; Major role in the acquisition of data; Study concept or design
Drew Kern, MD	Departments of Neurology and Neurosurgery, University of Colorado Anschutz Medical Campus, Aurora, CO	Drafting/revision of the manuscript for content, including medical writing for content; Major role in the acquisition of data; Analysis or interpretation of data
Julienne L. Bemski, DO	Swedish Medical Center, Family Residency Program, Denver CO	Drafting/revision of the manuscript for content, including medical writing for content; Analysis or interpretation of data

Appendix (continued)

Name	Location	Contribution
Ian Shelton, BA	Pharmacology Graduate Program, University of Colorado Anschutz Medical Campus, Aurora, CO	Drafting/revision of the manuscript for content, including medical writing for content; Major role in the acquisition of data; Analysis or interpretation of data
Martha Meyer, PhD	Department of Health Care Policy and Research, University of Colorado Anschutz Medical Campus, Aurora, CO	Major role in the acquisition of data; Analysis or interpretation of data
Benzi M. Kluger, MD, MS	Departments of Neurology and Medicine, University of Rochester Medical Center, Rochester, NY	Drafting/revision of the manuscript for content, including medical writing for content; Major role in the acquisition of data; Study concept or design; Analysis or interpretation of data

References

- Institute of Medicine. *Dying in America: Improving Quality and Honoring Individual Preferences Near the End of Life*. The National Academies Press; 2014.
- Cassel JB, Kerr KM, Kalman NS, Smith TJ. The business case for palliative care: translating research into program development in the U.S. *J Pain Symptom Manage*. 2015;50(6):741-749.
- May P, Garrido MM, Cassel JB, et al. Cost analysis of a prospective multi-site cohort study of palliative care consultation teams for adults with advanced cancer: where do cost-savings come from? *Palliat Med*. 2017;269216317690098.
- Khandelwal N, Curtis JR. Economic implications of end-of-life care in the ICU. *Curr Opin Crit Care*. 2014;20(6):656-661.
- Khandelwal N, Benkeser D, Coe NB, Engelberg RA, Teno JM, Curtis JR. Patterns of cost for patients dying in the intensive care unit and implications for cost savings of palliative care interventions. *J Palliat Med*. 2016;19(11):1171-1178.
- Centers for Disease Control and Prevention. Health expenditures; 2015. cdc.gov/nchs/fastats/health-expenditures.htm. Accessed February, 2017.
- Committee on the Learning Health Care System in America. In Smith M, Saunders R, Stuckhardt L, McGinnis JM, editors. *Best Care at Lower Cost: The Path to Continuously Learning Health Care in America*: National Academies Press (US) Copyright 2013 by the National Academy of Sciences. All rights reserved; 2013.
- VanLare JM, Conway PH. Value-based purchasing—national programs to move from volume to value. *N Engl J Med* 2012;367(4):292-295.
- Centers for Medicare Medicaid Services Hospital value-based purchasing program. cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/hospital-value-based-purchasing/index.html?redirect=/hospital-value-based-purchasing/. Accessed February, 2017.
- Brian Cassel J, Kerr KM, McClish DK, et al. Effect of a home-based palliative care program on healthcare use and costs. *J Am Geriatr Soc*. 2016;64(11):2288-2295.
- Lustbader D, Mudra M, Romano C, et al. The impact of a home-based palliative care program in an accountable care organization. *J Palliat Med*. 2017;20(1):23-28.
- Rabow M, Kvale E, Barbour L, et al. Moving upstream: a review of the evidence of the impact of outpatient palliative care. *J Palliat Med*. 2013;16(12):1540-1549.
- Davis MP, Temel JS, Balboni T, Glare P; JAO PM. A review of the trials which examine early integration of outpatient and home palliative care for patients with serious illnesses. *Ann Palliat Med*. 2015;4(3):99-121.
- Kluger BM, Miyasaki J, Katz M, et al. Comparison of integrated outpatient palliative care with standard care in patients with Parkinson disease and related disorders: a randomized clinical trial. *JAMA Neurol*. 2020;77(5):551-560.
- Veronese S, Gallo G, Valle A, et al. Specialist palliative care improves the quality of life in advanced neurodegenerative disorders: NE-PAL, a pilot randomised controlled study. *BMJ Support Palliat Care*. 2017;7(2):164-172.
- Isenberg SR, Lu C, McQuade J, et al. Impact of a new palliative care program on health system finances: an analysis of the palliative care program inpatient unit and consultations at Johns Hopkins medical institutions. *J Oncol Pract*. 2017;13(5):e421-e430.
- Khandelwal N, Brumback LC, Halpern SD, Coe NB, Brumback B, Curtis JR. Evaluating the economic impact of palliative and end-of-life care interventions on intensive care unit utilization and costs from the hospital and healthcare system perspective. *J Palliat Med*. 2017;20(12):1314-1320.
- Liu X, Dawod Y, Wonnapharhown A, et al. Effects of hospital palliative care on health, length of stay, and in-hospital mortality across intensive and non-intensive-care units: a systematic review and meta-analysis. *Palliat Support Care*. 2017;15(6):741-752.
- May P, Normand C, Cassel JB, et al. Economics of palliative care for hospitalized adults with serious illness: a meta-analysis. *JAMA Intern Med*. 2018;178(6):820-829.

20. May P, Normand C, Morrison RS. Economic impact of hospital inpatient palliative care consultation: review of current evidence and directions for future research. *J Palliat Med.* 2014;17(9):1054-1063.
21. McCarthy IM, Robinson C, Huq S, Philastre M. Cost savings from palliative care teams and guidance for a financially viable palliative care program. *Health Serv Res.* 2015;50(1):217-236.
22. Smith S, Brick A, O'Hara S, Normand C. Evidence on the cost and cost-effectiveness of palliative care: a Literature Review. *Palliat Med.* 2014;28(2):130-150.
23. Youens D, Moorin R. The impact of community-based palliative care on utilization and cost of acute care hospital services in the last year of life. *J Palliat Med.* 2017;20(7):736-744.
24. Luta X, Ottino B, Hall P, et al. Evidence on the economic value of end-of-life and palliative care interventions: a narrative review of reviews. *BMC Palliat Care.* 2021;20(1):89.
25. Erhun F, Mistry B, Platchek T, Milstein A, Narayanan VG, Kaplan RS. Time-driven activity-based costing of multivessel coronary artery bypass grafting across national boundaries to identify improvement opportunities: study protocol. *BMJ Open.* 2015; 5(8):e008765.
26. Kaplan RS, Porter ME. How to solve the cost crisis in health care. *Harv Bus Rev.* 2011; 89(9):46-52.
27. Porter ME. What is value in health care? *N Engl J Med.* 2010;363(26):2477-2481.
28. Keel G, Savage C, Rafiq M, Mazzocato P. Time-driven activity-based costing in health care: a systematic review of the literature. *Health Policy.* 2017;121(7):755-763.
29. Kaplan RS, Witkowski M, Abbott M, et al. Using time-driven activity-based costing to identify value improvement opportunities in healthcare. *J Healthc Manag.* 2014;59(6):399-412.
30. Ken Lee KH, Matthew Austin J, Pronovost PJ. Developing a measure of value in health care. *Value Health.* 2016;19(4):323-325.
31. McLaughlin N, Burke MA, Setlur NP, et al. Time-driven activity-based costing: a driver for provider engagement in costing activities and redesign initiatives. *Neurosurg Focus.* 2014;37(5):E3.
32. Kluger BM, Persenaire MJ, Holden SK, et al. Implementation issues relevant to outpatient neurology palliative care. *Ann Palliat Med.* 2018;7(3):339-348.
33. Sharan AD, Schroeder GD, West ME, Vaccaro AR. Understanding time-driven activity-based costing. *Clin Spine Surg.* 2016;29(2):62-65.
34. Bureau of Labor Statistics. *Pay and Benefits*; 2018. [bls.gov/data/#wages](https://www.bls.gov/data/#wages). Accessed November 10, 2018.
35. Becker's ASC Review. 21 *Statistics on ASC Square Footage + Rent, Occupancy Costs*; 2020. beckersasc.com/benchmarking/21-statistics-on-asc-square-footage-rent-occupancy-cost.html. Accessed June 2020.
36. Willis E, Semple AC, de Waal H. Quantifying the benefits of peer support for people with dementia: a Social Return on Investment (SROI) study. *Dementia.* 2018;17(3): 266-278.
37. Connolly S. Economics of dementia: a review of methods. *Dementia.* 2020;19(5): 1426-1440.

Updated Neurology® Clinical Practice Mission & Vision

With its updated vision and mission, *Neurology: Clinical Practice* has committed to carving out a novel, refreshing niche in clinical research within the AAN family of journals.

- **Vision:** *Neurology: Clinical Practice* will be the premier peer-reviewed journal to improve patient outcomes in clinical neurology.
- **Mission:** *Neurology: Clinical Practice* aims to help clinicians provide unbiased, high-quality care for all neurologic patients. We prioritize papers that address quality, patient outcomes, and practice-related topics.

Learn more at: [NPub.org/NCP/about](https://www.npub.org/NCP/about)

Neurology® Clinical Practice

Cost and Return on Investment of a Team-Based Palliative Care Program for Parkinson Disease

Robert Brett McQueen, Mark Gritz, Drew Kern, et al.

Neurol Clin Pract 2022;12;429-437 Published Online before print October 26, 2022

DOI 10.1212/CPJ.0000000000200103

This information is current as of October 26, 2022

Updated Information & Services	including high resolution figures, can be found at: http://cp.neurology.org/content/12/6/429.full.html
References	This article cites 30 articles, 2 of which you can access for free at: http://cp.neurology.org/content/12/6/429.full.html##ref-list-1
Citations	This article has been cited by 1 HighWire-hosted articles: http://cp.neurology.org/content/12/6/429.full.html##otherarticles
Permissions & Licensing	Information about reproducing this article in parts (figures, tables) or in its entirety can be found online at: http://cp.neurology.org/misc/about.xhtml#permissions
Reprints	Information about ordering reprints can be found online: http://cp.neurology.org/misc/addir.xhtml#reprintsus

Neurol Clin Pract is an official journal of the American Academy of Neurology. Published continuously since 2011, it is now a bimonthly with 6 issues per year. Copyright © 2022 The Author(s). Published by Wolters Kluwer Health, Inc. on behalf of the American Academy of Neurology. All rights reserved. Print ISSN: 2163-0402. Online ISSN: 2163-0933.

