RTI Press

Occasional Paper

January 2017

Using Medicare Cost Reports to Calculate Costs for Post-Acute Care Claims

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RTI INTERNATIONAL

RTI Press publication OP-0036-1701

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Suggested Citation

Coomer, N.M., Ingber, M.J., Coots, L., and Morley, M. (2017). *Using Medicare Cost Reports to Calculate Costs for Post-Acute Care Claims*. RTI Press Publication No. OP-0036-1701. Research Triangle Park, NC: RTI Press. http://doi.org/10.3768/rtipress.2017.op.0036.1701

This publication is part of the RTI Press Research Report series. Occasional Papers are scholarly essays on policy, methods, or other topics relevant to RTI areas of research or technical focus.

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Acknowledgments

This research was supported by RTI International. We thank our colleagues Allison Briggs and Amy Kandilov who provided insight and expertise that greatly assisted the research.

Abstract

In this paper, we describe technical approaches for calculating costs associated with Medicare post-acute care provider claims, including long-term care hospitals (LTCHs), inpatient rehabilitation facilities (IRFs), home health agencies (HHAs), and skilled nursing facilities (SNFs), using Medicare cost report data (Healthcare Cost Report Information System, or HCRIS) and claims data. Analyses of resource utilization often focus on costs of providing medical care, rather than payments for medical care. Calculated costs more accurately reflect the claim-level costs to providers of providing care than the payments made to providers, which often include policy adjustments (such as disproportionate share payments for inpatient hospitals) that are not directly related to the costs of providing care.

Introduction

In this paper, we describe technical approaches for calculating costs associated with Medicare post-acute care (PAC) provider claims, including long-term care hospitals (LTCHs), inpatient rehabilitation facilities (IRFs), skilled nursing facilities (SNFs), and home health agencies (HHAs), using Medicare cost report data (Healthcare Cost Report Information System, or HCRIS) and claims data. Analyses of resource utilization often focus on costs of providing medical care, rather than payments for medical care. Calculated costs more accurately reflect the true costs of providing care than payments made to providers, which often include policy adjustments (such as disproportionate share payments for inpatient hospitals) that are not directly related to the costs of providing care. Costs have also been used as the basis for developing Medicare payment systems.

There are few studies that compare methods for calculating hospital costs. Two of these papers, Shwartz, Young, and Siegrist (1995) and Taira and colleagues (2003) find that hospital-level cost-center–specific cost-to-charge ratios (CCRs) produce costs closest to actual hospital costs. Hayman, Lash, Tao, and Halman (2000) posit that Medicare payments are the closest to actual hospital cost and that hospital-level cost-center–specific CCRs overestimate costs, whereas research by Burkhardt and Sunshine (1999) suggests that both Medicare payments and total charges overestimate actual hospital costs.

Each approach to calculating claims cost has its own pros and cons. Using Medicare payments as costs is very simple and requires no additional computation from the claims. However, Medicare payments themselves are not equivalent to the costs to the provider of providing care to the patient. Medicare payments include policy adjustments that systematically increase or decrease the payments to certain facilities that are not related to the costs for specific patients. Overall hospital CCRs are more computationally complex but are not too resource intensive because only one value is needed per facility. However, the overall facility CCR is very general and does not align costs closely with the services provided to each patient. Thus patients with similar total claim charges, regardless of actual services used, will have the same calculated costs.

Using cost-center–specific CCRs allows the cost calculation to be more closely aligned with the services that are actually provided to a patient. However, this method is the most computationally complex and resource intensive. The hospital-level cost-center–specific approach is the most widely used method in the literature (ResDAC 2013).

In this paper, we expand the Medicare cost report method of hospital claim cost calculation to claims for Medicare-covered stays at PAC providers. The approaches for calculating costs vary by PAC provider type and require the use of the Medicare cost report data and Medicare claims data. The claims referred to in this analysis are the Medicare Standard Analytic Files (SAFs), which provide revenue-center–level detail for the cost calculation. The Medicare Provider Analysis and Review (MedPAR) data set is another potential source of Medicare inpatient-stay–level information where revenue centers are aggregated across the claim lines and the reported aggregations are very similar to those used in this work. These claims files can be accessed in several ways including through the Chronic Condition Warehouse (CCW) and the Integrated Data Repository (IDR). For inpatient PAC providers (LTCH, IRF, and SNF), we describe a method that uses a combination of routine and special care costs and provider-level cost-center–specific CCRs for ancillary services. We also describe a method for IRFs and LTCHs that uses CCRs for routine and special care costs. For HHAs, which provide services to beneficiaries in their homes, we describe a method that calculates the cost per visit by visit type and the cost of supplies. We identified cost information by using Medicare cost reports; to calculate claim-level costs, we used this cost information in conjunction with claims data on charges and visit counts.

We aim to present the technical approaches for calculating claim-level costs for Medicare claims, and as such, we assume the reader is familiar with the structure and content of Medicare claims and Medicare cost report data.

http://doi.org/10.3768/rtipress.2017.op.0036.1701

Overview of Medicare Cost Reports

Institutional providers certified by the Medicare program are required to submit cost reports to Medicare Administrative Contractors (MACs) annually (Centers for Medicare and Medicaid Services [CMS], 2016). CMS makes cost report data available for providers who have passed all HCRIS edits, similar to an auditing process. HCRIS may reject some cost reports, and in these cases, the MACs are responsible for correcting and resubmitting data.

Each year of cost report files includes a report and raw data, which are linkable using a unique identifier. The report contains the provider number, dates, and report status (e.g., settled, as submitted, reopened). The alphanumeric data file includes all text entered on the cost report, such as name, address, and fields requiring yes/no responses; the numeric file includes fields such as costs, charges, and ratios. These files are available by fiscal year and are updated quarterly.

Claims data are often used by calendar year, not fiscal year like the cost report data. Thus, service dates associated with claims may span more than one cost report, requiring the analyst to develop decision rules about which cost report should be matched to cover these claims. For example, a long SNF stay that crosses the fiscal year may be parsed out to match the cost reports corresponding with the dates of service. Alternatively, an analyst may determine what proportion of the SNF stay falls in each fiscal year and match the SNF claim with the cost report that covers the majority of the SNF stay. For simplicity, matching either the admission or discharge date with the corresponding cost report may also be practical.

The hospital and SNF cost reports have both 1996 (2552–96, 2540–96) and 2010 (2552–10, 2540–10) versions, whereas the HHA cost reports have only a 1994 version (1728–94). The methods presented for calculating costs from the Medicare cost reports can be applied to the 1994 version for HHA cost reports, which is still in use, the 1996 version for hospital and SNF cost reports, which was in use from 1996 to 2011 for hospitals and to 2012 for SNFs, and the 2010 version for hospital and SNF cost reports, which has been in use since 2010 for hospitals and since 2011 for SNFs. We provide detailed information (worksheet, column, and line numbers) for identifying the cost report fields on all versions of the cost reports, as applicable. For hospital-based SNFs, hospital-based HHAs, hospital-based IRFs (IRF units), and SNF-based HHAs, we associate the locations of the cost report fields with the relevant subprovider worksheets. For LTCHs, freestanding SNFs, freestanding HHAs, and freestanding IRFs, we associate the cost report fields with the main provider worksheets. For all provider types, analysts should use the Medicare (Title XVIII) worksheets for determining Medicare costs when applicable.

The Medicare cost reports include hospital costs for Medicaid and other third-party–payer patients in addition to Medicare. Analysts may be interested in calculating costs for claims from payers other than Medicare. One can readily adapt the methods presented here to these situations by selecting costs on the worksheets associated with Title XIX (Medicaid) or the hospital overall. Additionally, analysts can adapt the selection of ancillary CCRs by ungrouping the categories suggested below to best match the data in question. The cost reports include significant detail that analysts can use to answer a variety of research questions related to overall hospital costs as well as components of costs such as medical education, operating costs, capital costs, and so forth. The following recommendations assume that these types of costs are not separated out.

Calculating Costs for Inpatient Facilities

To calculate the costs for LTCHs and freestanding IRFs, analysts should use the main provider worksheets of the Medicare hospital cost reports. Analysts should use the SNF cost reports to calculate the costs for freestanding SNFs and should use the subprovider worksheets of the hospital cost report associated with the unit to calculate the costs for SNF and IRF units.

The approach presented here calculates three types of costs: routine, special care, and ancillary; however, special care costs are not relevant for SNFs. Routine costs are costs for services that are typically provided to all patients such as nursing and room and board. Special care costs include costs for specialized

services such as intensive care (including surgical and burn) and coronary care. Ancillary costs are associated with services provided to patients outside of routine and special care, such as radiology, laboratory, physical therapy, and supplies. These costs are calculated separately and summed in order to generate the total claim cost. Ancillary costs for a stay, must be computed using claim charges in addition to cost report information for IRFs, SNFs, and LTCHs.

Calculating Routine and Special Care Cost per Day

Routine costs per day for IRFs and LTCHs are calculated as total cost minus inpatient program pass-through costs (if >0) divided by Title XVIII days.[1] For SNFs, the calculation is more complex. Many facilities treat a mix of skilled nursing and unskilled nursing patients. Thus, the routine per diem cost on most SNF cost reports is actually an average of costs per day for both skilled and nonskilled nursing patients.

[1] Pass-through costs are costs that are not included in PPS payments typically including medical education, capital expenditures, insurance and interest on fixed assets. Title XVIII is Health Insurance for the Aged and Disabled (Medicare).

Additionally, the cost reports do not provide routine cost per day for Medicare patients separate from all patients. Average costs per day on the costs reports, therefore, systematically underestimate the costs for Medicare patients, which are typically the skilled nursing patients. The Medicare Payment Advisory Commission (MedPAC, 2010) has reported that Medicare patients use more nursing services in SNFs than non-Medicare patients. The approach presented here adjusts routine costs following the same method used by MedPAC, which sets the Medicare nursing component at 1.346 times the non-Medicare nursing component and assumes that nursing is 40 percent of the cost per day. To account for this, routine costs are adjusted using the following formula:

$$\text{Adjusted Routine Cost per Day} = w*C+[(1-w)*(0.6*C+0.4*1.346*C)],$$

where w is the proportion of Medicare-covered SNF days (Medicare-covered SNF days/total SNF days) and C is the total cost for SNF divided by total days for SNF. Table 1 outlines the locations of the cost per day components for both the 1996 and 2010 versions of the hospital and SNF cost reports.

Table 1. Location of routine-cost-per-day components on the cost reports for inpatient facilities

IRF and LTCH	Routine cost	Title XVIII days	Pass-through
2552–96			
Freestanding IRFs and LTCHs	D1II, column 1, line 41	S3I, column 4, line 1	DIII, column 8, line 25
IRF units	D1II, column 1, line 41	S3I, column 4, line 14	D1II, column 1, line 50
2552–10			
Freestanding IRFs and LTCHs	D1II, column 1, line 41	S3I, column 6, line 1	DIII, column 9, line 30
IRF units	D1II, column 1, line 41	S3I, column 6, line 17	D1II, column 1, line 50
SNF	**Total cost**	**Title XVIII days***	**Total SNF days**
2540–96 (SNF); 2552–96 (Hospital)			
Freestanding	BI, column 18, line 16	S3I, column 4, line 1	S3I, column 7, line 1
Hospital-based	BI, column 27, line 34	S3I, column 4, line 15	S3I, column 6, line 15
2540–10(SNF); 2552–10 (Hospital)			
Freestanding	BI, column 18, line 30	S3I, column 4, line 1	S3I, column 7, line 1
Hospital-based	BI, column 26, line 44	S3I, column 6, line 19	S3I, column 8, line 19

Notes: BI = Worksheet B Part I; D1II = Worksheet D-1 Part II (for units, the references for Worksheet D1II require use of the relevant subprovider worksheets); DIII = Worksheet D Part III; IRF = inpatient rehabilitation facilities; LTCH = long-term care hospitals; S3I = Worksheet S-3 Part I; SNF = skilled nursing facility.

* Medicare-covered SNF days

http://doi.org/10.3768/rtipress.2017.op.0036.1701

Analysts should calculate special care costs per day for LTCHs and freestanding IRFs as the sum of the costs for intensive care, coronary care, burn intensive care, surgical intensive care, and other special care units minus the sum of their respective pass-through costs divided by the sum of their respective Title XVIII days. For IRF units, the cost report subprovider worksheets do not include information on pass-through costs. Therefore, analysts should calculate special care costs per day as the sum of the costs for intensive care, coronary care, burn intensive care, surgical intensive care, and other special care units divided by the sum of their respective Title XVIII days. Table 2 shows the locations of the special care cost components in the Medicare hospital cost reports.

Calculating the special care cost per day is not always necessary for IRFs. Analysis of the presence of special care revenue center codes on a sample of 11,258 IRF claims for freestanding IRF and IRF unit lines from 2008 through 2010 found that less than 0.035% reported any special care revenue centers. Analysts should check claims data to determine whether IRF claims indicate the need to calculate special care costs.

Calculating Ancillary Cost

The first step to calculating ancillary costs is to calculate the ancillary CCRs from the Medicare cost reports. The cost reports contain cost centers at various levels of aggregation; additionally, the cost centers on the cost reports can be aggregated beyond the levels shown in the cost reports themselves. Analysts need to consider the trade-off between the level of cost detail and computational convenience, including data editing issues, in relation to specific research needs and resource availability. If, for example, an analysis was to focus on the costs associated with magnetic resonance imaging (MRI) services, then using the MRI-specific cost centers would prevent loss of specificity that would occur when aggregating up to a general radiology cost center. When selecting the level of cost centers to use, analysts should consider several factors beyond potentially gaining more specificity. Not all facilities report the more specific cost centers on the Medicare cost reports; and when using these cost centers, it is common to see data that are extreme. Analysts should perform additional validity tests on the data for extreme values. Using more specific cost centers will often require an analyst to make many more judgment calls regarding imputing missing values and controlling for erroneous values.

We have selected 14 ancillary cost center groupings to include in the IRF and LTCH cost calculation shown in Table 3. We chose these specific cost centers because they correspond to the aggregation of revenue center codes used by CMS in the MedPAR claims. The 2552–96 cost reports use Worksheet D–4 for the total cost (column 3) and total charges (column 2) and Worksheet D Part 4 for the pass-through costs (column 7) for the ancillary CCRs. The 2552–10 cost reports use Worksheet D–3 for the total cost (column 3) and total charges (column 2) and Worksheet D Part 4 for the pass-through costs (column 11) for the ancillary CCRs. Table 3 shows the relevant lines.

Table 2. Location of special care cost per day components on the cost reports for long-term care hospitals and inpatient rehabilitation facilities

Facility type	Special care cost	Title XVIII days	Pass-through
2552–96			
Freestanding IRFs and LTCHs	D1II, column 5, lines 43–47	D1II, column 2, lines 43–47	DIII, column 8, lines 26–30
IRF units	D1II, column 5, lines 43–47	D1II, column 2, lines 43–47	n/a
2552–10			
Freestanding IRFs and LTCHs	D1II, column 5, lines 43–47	D1II, column 2, lines 43–47	DIII, column 9, lines 31–35
IRF units	D1II, column 5, lines 43–47	D1II, column 2, lines 43–47	n/a

Notes: D1II = Worksheet D-1 Part II (for units, the references for Worksheet D1II require use of the relevant subprovider worksheets); DIII = Worksheet D Part III; IRF = inpatient rehabilitation facilities; LTCH = long-term care hospitals; n/a=not applicable.

Table 3. Line location for the ancillary cost centers for long-term care hospitals and inpatient rehabilitation facilities

Ancillary cost center	Lines included	Line on 2552–96	Line on 2552–10
Anesthesia	Anesthesia	40	53
IV Therapy	Intravenous Therapy	48	64
Respiratory Therapy	Respiratory Therapy	49	65
Physical Therapy	Physical Therapy	50	66
Occupational Therapy	Occupational Therapy	51	67
Speech Pathology	Speech Pathology	52	68
Drug	Drugs Charged to Patients	56	73
Operating Room	Operating Room, Recovery Room	37, 38	50, 51
Radiology	Radiology-Diagnostic, Radiology-Therapeutic, Radioisotope (for 2552–10 the lines for CT, MRI, and cardiac catheterization are also included)	41, 42, 43	54, 55, 56, 57, 58, 59
Laboratory	Laboratory, Electrocardiology, Electroencephalography	44, 53, 54	60, 69, 70
Blood	Whole Blood & Packed Red Blood Cells, Blood Storing, Processing, and Transfusing	46, 47	62, 63
Supplies	Medical Supplies Charged to Patients, Durable Medical Equipment-Rented, Durable Medical Equipment-Sold (for 2552–10 Implantable Devices Charged to Patients)	55, 66, 67	71, 72, 96, 97
Renal	Renal Dialysis, Home Program Dialysis	57, 64	74, 94
Other	ASC (Non-Distinct Part), Other Ancillary, Clinic, Emergency, Observation Beds, Other Outpatient Service, Other Reimbursable (for 2552–10 FQHC and RHC are also included)	58, 59, 60, 61, 62, 63, 68	75, 76, 88, 89, 90, 91, 92, 93, 98

Notes: ASC = ambulatory surgical center; CT = computerized tomography; FQHC = federally qualified health center; MRI = magnetic resonance imaging; RHC = rural health center.

Analysts should calculate the CCRs for each ancillary cost center as total cost minus pass-through costs (if >0), divided by total charges for each component.

For SNFs, the ancillary costs that are available for inclusion in the calculation differ between freestanding and hospital-based SNFs because of the different Medicare cost reports submitted by the providers. We selected 11 ancillary cost-center groupings to include in the freestanding SNF calculation and 9 to include in the hospital-based SNF calculation. As with IRFs and LTCHs, we chose these specific cost centers because they correspond to the aggregation of revenue center codes used by CMS in the MedPAR claims. Table 4 presents the ancillary cost centers for each type of provider. For freestanding SNFs, the ancillary CCRs are located in the SNF cost report on Worksheet C, column 3. For hospital-based SNFs, we calculate the ancillary CCRs as total cost divided by total charges located in the hospital cost report on subprovider Worksheet D Part 4, columns 4 and 3 respectively for the 2552–96 cost reports and subprovider Worksheet D–3 columns 3 and 2 respectively for the 2552–10 cost reports. Table 4 presents the relevant cost report lines for each of the ancillary costs.

Once analysts have calculated ancillary CCRs and have addressed missing values and outliers (discussed below), they can calculate ancillary cost per claim by multiplying the ancillary CCRs by the charges in the analogous revenue centers on the claim (see, for example, Table 5) and summing. For the ancillary cost centers, each facility may not provide every service. In cases in which a service is not provided, the claim charges for the analogous revenue center will be zero or missing, excluding the cost center from the claim cost calculation.

http://doi.org/10.3768/rtipress.2017.op.0036.1701

Table 4. Cost report lines for ancillary costs for SNFs

	Cost report line			
Ancillary cost type	**Freestanding 2540–96**	**Hospital-based 2552–96**	**Freestanding 2540–10**	**Hospital-based 2552–10**
Drugs	23, 30	48, 56	42, 49	64, 73
Electrocardiology	28	53	47	69
Laboratory	22	44, 54	41	60, 70
Medical Supplies	29	55, 66, 67	48	71, 96, 97
Occupational Therapy	26	51	45	67
Other Ancillary	33	58–63, 68	52	75, 76, 90–93, 98
Oxygen/Inhalation Therapy	24	—	43	—
Physical Therapy	25	50	44	66
Radiology	21	41, 42, 43	40	54, 55, 56
Speech Therapy	27	52	46	68
Support Surfaces	32	—	51	—

Table 5. Ancillary revenue centers for long-term care hospitals and inpatient rehabilitation facilities

Ancillary cost type	Revenue center
Anesthesia	037X
Blood	038X, 039X
Drug	025X, 063X
IV Therapy	026X
Laboratory	030X, 031X, 073X, 074X, 075X
Occupational Therapy	043X
Physical Therapy	042X
Speech Therapy	044X, 047X
Operating Room	036X, 071X
Radiology	028X, 032X, 033X, 034X, 035X, 040X, 061X, 0481*
Renal	080X, 082X, 083X, 084X, 085X, 088X
Respiratory	041X, 046X
Supplies	027X, 029X, 062X
Other	0002–0099, 022X, 023X, 024X, 045X, 049X, 050X, 051X, 052X, 053X, 055X, 056X, 057X, 058X, 059X, 060X, 064X, 065X, 066X, 067X, 070X, 076X, 077X, 078X, 090X, 091X, 092X, 093X, 094X

Notes: X = 0–9. Adapted from the revenue center roll-ups used in the Medicare Provider Analysis and Review (MedPAR) File

* Revenue center 0481 is for cardiac catheterization and should be included only when using the 2552–10 version of the cost reports.

Calculating Claim Cost

Claim cost is calculated in four steps for LTCHs and IRFs:

1. Calculate routine and special care days. Special care days are the sum of the intensive care and coronary care days on the beneficiary's claim, and routine care days are the total claim days minus special care days.
2. Multiply the routine cost per day by the number of routine days on the beneficiary's claim.
3. Multiply the special care cost per day by the number of special care days on the beneficiary's claim.
4. Sum the resulting costs from (2) and (3) and the ancillary costs per claim.

The SNF claim cost is calculated by multiplying the routine cost per day by the number of utilization days (Medicare-covered days) on the beneficiary's claim and adding the ancillary costs per claim.[2]

[2] MedPAR claims data do not differentiate beyond intensive care unit (ICU) and coronary care unit (CCU) days for intensive care.

http://doi.org/10.3768/rtipress.2017.op.0036.1701

An Alternative to Calculating IRF and LTCH Routine and Special Care Costs per Day

It is possible that providers may not report separate cost centers for different levels of nursing care but may still charge higher rates leading to average costs per day overstating the costs of the less severely ill patients and understating the costs of the more severely ill patients. Alternatively, researchers may consider using CCRs to calculate the routine and special care costs.

Following this method, analysts should first calculate Medicare-specific CCRs from the Medicare cost reports. They should calculate CCRs as total cost minus pass-through costs (if >0) divided by total charges for each component (routine, intensive care, coronary care, burn intensive care, surgical intensive care, and other special care). Then, for routine costs, analysts should multiply the routine CCR by the Medicare routine care charges on the claim to calculate routine costs. To calculate the special care costs, analysts should multiply each component CCR by the component specific total charges from the cost report to calculate the component specific costs. To create a special care CCR, they should sum the five component specific costs and divide by the sum of the component specific charges. Then analysts should multiply the special care CCR by the Medicare special care charges on the claim to calculate special care costs. They can then calculate claim costs by summing the routine, special care and ancillary costs. Table 6 outlines the locations of components for calculating the routine and special care CCRs for both the 1996 and 2010 versions of the hospital cost reports.

Calculating Costs for Home Health Agencies

Unlike inpatient costs, which analysts calculate by day or based on the patient's length of stay, analysts calculate HHA costs per visit. HHAs can be freestanding, hospital-based, or SNF-based, and for each type of HHA, the method for calculating costs is the same. Analysts use the HHA cost reports for freestanding HHAs and use the HHA subprovider worksheets from the hospital and SNF cost reports for the hospital-based and SNF-based HHAs, respectively. The HHA cost report version has not been updated since 1994 (1728–94), whereas the hospital and SNF cost reports have both 1996 (2552–96, 2540–96) and 2010 (2552–10, 2540–10) versions.

Table 6. Alternative method for routine and special care costs using CCRs for inpatient rehabilitation facilities and long-term care hospitals

Facility type	Title XVIII charges	Title XVIII costs	Pass-through
2552–96			
Freestanding IRFs and LTCHs	D4, column 2, lines 25–30	D1II, column 1, line 41, and D1II, column 5, lines 43–47	DIII, column 8, lines 25–30
IRF units	D4, column 2, lines 25–30	D1II, column 1, line 41, and D1II, column 5, lines 43–47	n/a
2552–10			
Freestanding IRFs and LTCHs	D3, column 2, lines 30–35	D1II, column 1, line 41, and D1II, column 5, lines 43–47	DIII, column 9, lines 30–35
IRF units	D3, column 2, lines 30–35	D1II, column 1, line 41, and D1II, column 5, lines 43–47	n/a

Notes: D3 = Worksheet D–3, D4 = Worksheet D–4, D1II = Worksheet D–1 Part II; DIII = Worksheet D Part III; for units, the references for Worksheets D1II, D3, and D4 require use of the relevant subprovider worksheets.

http://doi.org/10.3768/rtipress.2017.op.0036.1701

Calculating Cost per Visit and the Supplies CCR

HHAs provide several types of services to patients through in-home visits. These visits include skilled nursing, physical therapy, occupational therapy, speech pathology, medical social services, and home health aide services. For HHAs, the method that we present here calculates the cost of the claim as the cost of all the visits and supplies that a patient received. This method uses the average cost per visit from the cost reports for each of the six visit types plus a supplies CCR. The supplies cost is calculated at the claim level rather than at the visit level because of how supplies charges are recorded on the Medicare claims. Table 7 details the location on each cost report for the cost per visit and the supplies CCR.

Table 7. Location of HHA cost per visit and supplies CCR on the cost reports

HHA type	Cost per visit	Supplies CCR
1728–94 (HHA)		
Freestanding	CI, column 4, lines 1–6	CIII, column 4, line 15
2552–96 (Hospital); 2540–96 (SNF)		
Hospital-based	H6I, column 5, lines 1–6	H6I, column 5, line 15
SNF-based	H5, column 4, lines 1–6	H4II, column 2, line 4
2552–10 (Hospital); 2540–10 (SNF)		
Hospital-based	H3I, column 5, lines 1–6	H3I, column 5, line 15
SNF-based	H3I, column 5, lines 1–6	H3I, column 5, line 15

Notes: CI is Worksheet C Part I; CIII = Worksheet C Part III; H6I = Worksheet H–6 Part I; H5 = Worksheet H–5; H4II = Worksheet H–4 Part II; H3I = Worksheet H–3 Part 1.

Calculating Claim Cost

Analysts should calculate claim cost by multiplying the average cost per visit by the number of visits for each visit type and the medical supplies CCR by the charges for supplies and then summing across the visit types and supplies cost.

Missing Data and Outliers

On occasion, the data in the Medicare cost reports are incomplete, missing, or erroneous. In this section, we detail methods for handling outliers and imputation that are computationally simple and not very resource intensive.

Data may be entirely missing for a provider in the Medicare claims data or components of the routine or special care costs per day, ancillary CCRs, or HHA visits may be missing. When this occurs, analysts may still need to include a provider in their work. To do so, the missing values can be imputed. Routine and special care costs per day, ancillary CCRs, and HHA visit costs should each be imputed separately. Additionally, the imputation should be done separately for freestanding, hospital-based, and SNF-based providers due to the differences in their cost structures. Only missing data should be imputed; it is possible, and likely, that providers will have a value of zero for special care (IRFs and LTCHs), some ancillary services (IRF, LTCHs and SNFs), or visit types (HHAs), which can be valid. In these cases, imputing missing cost report data will not affect claims data analysis because the claims will not include charges for the services with imputed costs.

Analysts can impute the missing routine and special care costs per day as the respective median cost per day for the facility type. Imputing ancillary CCRs can be more difficult because some CCRs are missing for the majority of providers. For these CCRs, there are several options for analysts to consider. Analysts may exclude the ancillary cost centers from the cost calculation, impute the missing CCRs, or set the missing CCRs to zero under the assumption that the provider did not offer those ancillary services. The latter retains the cost information for the providers that provided data while not imputing values based on a small, possibly nonrandom, sample of providers.

For providers with missing values for some, but not all, ancillary costs, analysts may use information from the nonmissing CCRs to inform the imputation rather than simply imputing values to the median. One approach is to impute a missing CCR for a given ancillary cost center for a provider based on

the provider's relative percentage from the national median across all available (i.e., nonmissing) ancillary cost types. For example, if a SNF had a missing CCR for physical therapy and the CCRs for the other cost centers averaged 150% of the national median, then the imputed value for the physical therapy CCR would be estimated at 150% of the median CCR for physical therapy. If a provider is missing from the cost report data entirely or missing all values for the ancillary CCRs, then the sample or national median of each CCR can be imputed for that provider at analysts' discretion.

For HHAs with missing values for some, but not all, of the visit types, it is possible to use information about the nonmissing visit types to inform the imputation as was described for the CCRs for LTCHs, IRFs, and SNFs. Analysts can impute a missing supplies CCR as the median supplies CCR for the respective provider type.

Often the data in the cost reports contain errors that lead to unrealistically high or low routine or special care costs per day, CCRs, or costs per visit. In these instances, analysts may wish to Winsorize the data to prevent outliers from driving the results of subsequent analyses. As with imputation, analysts should perform the Winsorizing separately for each cost type. Further, analysts should perform the Winsorizing separately for freestanding and hospital-based IRFs, SNFs and HHAs, and SNF-based HHAs. Analysts should determine the level at which the Winsorizing is performed (e.g. 1st and 99th percentiles) based on the distributions in the data for the routine cost per day, special care cost per day, each CCR, and cost per visit, separately.

There are several other methods that analysts may choose to use for handling outliers such as identifying outliers using geometric means, setting extreme values to missing and then replacing missing values using multiple imputation, or using within-provider interpolation across years. Likewise, analysts can use other imputation methods—for example, the aforementioned multiple imputation and within-provider interpolation. These alternative methods are more computationally complex and resource intensive than those that we describe in detail above.

Discussion of Limitations

Analysts should consider several limitations when calculating costs for Medicare claims using Medicare cost report data. These limitations, in large part, concern the availability and accuracy of the Medicare cost report data itself.

Medicare cost report data are often incomplete, and frequently data fields are inaccurately reported when the forms are completed. When dealing with the cost report data, analysts must examine the distributions and counts of missing fields carefully. We detailed important considerations and technical approaches for identifying and addressing issues such as Winsorization of outlier values and imputation of missing data. Our approach gives analysts flexibility and greater control when addressing these commonly encountered issues with Medicare cost report data.

Additionally, Medicare claims data can contain errors related to the number of visits or days on a claim or the charge amounts reported. Analysts should take care to thoroughly examine the claims data for such anomalies, which may require additional Winsorization or imputation prior to being combined with the data from the cost reports.

Analysts should note that cost centers are used in the cost report data; whereas, revenue center codes are used in the claims data. There is no official crosswalk that maps cost and revenue centers; thus, researchers must map these to assign the CCRs to the correct revenue center. Providers may vary in the level of detail in which they report costs and revenue centers. Radiology costs, for example, might be broken out into individual services (e.g., X-rays, MRIs, CT scans), or combined, so groups of services may have to be summed. Each hospital may have its own version of mapping revenue codes to cost centers, which itself creates variation. Mapping revenue codes to cost report centers is a complex and resource-intensive process. The greater the detail in the claims data that analysts attempt to match, the more judgment calls analysts will have to make about missing, extreme, or erroneous data. As such, analysts must weigh the additional computational gain from creating a mapping specific to each research project

http://doi.org/10.3768/rtipress.2017.op.0036.1701

against the resource constraints for that project. CMS publishes crosswalks that can assist analysts in this mapping.[3]

Another limitation to the methods detailed for estimating PAC costs is that they assume that the level of costs remains constant over the course of a stay or home health claim. However, that the level of care provided or intensity of services remains the same over a PAC stay is unlikely. Thus, the cost per day is an average and may not represent the costs for any one day or particular range of days within the claim.

The methods presented here for calculating costs for Medicare PAC claims are very time and resource intensive. Analysts need to consider the research questions that they are addressing carefully to determine whether the potential benefit of this method outweighs the cost of its implementation. Although the prior literature (Shwartz et al., 1995; Taira et al., 2003) has found that a cost-center–specific CCR method is the most accurate approach, time and resource constraints may require analysts to consider alternative costs measures, such as using overall provider CCRs for IRFs and LTCHs, Medicare-specific CCRs for an industry, or even using claim payment amounts (Asper, n.d.). These alternative approaches may be crude and less precise, but they are much easier to operationalize.

[3] An example of a crosswalk published for the Outpatient Prospective Payment System by the Centers for Medicare and Medicaid Services can be found here: https://www.cms.gov/apps/ama/license.asp?file=/Medicare/Medicare-Fee-for-Service-Payment/HospitalOutpatientPPS/Downloads/CMS-1613-FC-rev-code-to-cost-center-crosswalks.zip.

Conclusions

This paper expands claim-level hospital cost calculations to PAC providers. The approaches for calculating costs vary by PAC provider type and require the use of the Medicare cost report data and Medicare claims data. The methods for calculating PAC Medicare claim cost provide detailed information (worksheet, column and line numbers) for identifying the cost report fields and handling commonly arising issues of missing information and outliers. For institutional PAC providers, the methods presented are based on routine and special care costs per day and provider-level cost-center–specific CCRs. For HHAs, the method calculates costs per visit by type and a supplies cost, which are then summed. This type of approach is advantageous because it allows for more precise cost estimates and enables analysts to understand the components that drive overall provider costs.

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