

ONLINE APPENDIXES

7

**Measuring the effects of
medication adherence for the
Medicare population**

ONLINE APPENDIX

7-A

**CHF medications included
in the study, by drug group**

**TABLE
7-A1****CHF medications included in the study, by drug group**

Drug group	Drug name
Cardio-selective beta-blockers and alpha-beta-blockers (BBs)	<ul style="list-style-type: none">• Atenolol• Betaxolol hydrochloride• Bisoprolol fumarate• Carvedilol• Carvedilol phosphate• Metoprolol tartrate• Metoprolol succinate• Nebivolol hydrochloride
Angiotensin-converting enzyme (ACE) inhibitors	<ul style="list-style-type: none">• Benazepril hydrochloride• Captopril• Enalapril maleate• Fosinopril sodium• Lisinopril• Moexipril hydrochloride• Perindopril erbumine• Quinapril hydrochloride• Ramipril• Trandolapril
Angiotensin receptor blockers (ARBs)	<ul style="list-style-type: none">• Candesartan cilexetil• Eprosartan mesylate• Irbesartan• Losartan potassium• Olmesartan medoxomil• Telmisartan• Valsartan

Note: CHF (congestive heart failure).

ONLINE APPENDIX

7-B

Covariates used in the regression analyses

Adherence group indicators

Group 1:

Started on CHF medication(s) within 3 months of the qualifying CHF event and continued on any CHF medications for at least 6 months.

Group 2:

Started on CHF medication(s) within 3 months of the qualifying CHF event and discontinued using CHF medications within 6 months.

Group 3 (reference group):

Started on CHF medication(s) after more than 3 months had passed since the qualifying CHF event or did not start on CHF medications within 6 months of the qualifying CHF event.

Sociodemographic characteristics

Male (reference group)

Female

Age categories

≤ 69 (reference group)

70–74

75–79

80–84

85–89

90+

Deciles of Medicare reimbursements across HRRs

≤ 10% (reference group)

10%–20%

20%–30%

30%–40%

40%–50%

50%–60%

60%–70%

70%–80%

80%–90%

90%+

Median income in the area of residence (ZIP code)

≤ \$30,000 (reference group)

\$30,000–\$40,000

\$40,000–\$50,000

\$50,000–\$60,000

\$60,000–\$70,000

\$70,000–\$80,000

\$80,000+

Low-income subsidy status indicator

Urban Indicator

Note: CHF (congestive heart failure), HRR (hospital referral region).

Race
 White (reference group)
 Black
 Asian
 Hispanic
 Native American
 Other
 Unknown

Comorbidities

Number of illness categories in the 1 year before qualifying CHF event
 0 (reference group)
 1–2
 3+

Number of CHF-related illness categories in the 1 year before qualifying CHF event

Patterns of drug use

Number of unique drugs taken during the 6 months before qualifying CHF event
 0 (reference group)
 1–3
 4–6
 7–9
 10+

Number of prescribers
 < 2 (reference group)
 2+

Average medical spending per month during the 6 months before qualifying CHF event

< \$100 (reference group)
 \$100–\$200
 \$200–\$400
 \$400–\$800
 \$800–\$1,600
 \$1,600+

Survival status indicator

Death during months 1–6 after qualifying CHF event
 Death during months 7–12 after qualifying CHF event

Note: CHF (congestive heart failure), HRR (hospital referral region).

7-C
O N L I N E A P P E N D I X

**Comparison across different
cohort criteria**

**TABLE
7-C1****Comparison of regression results estimating average monthly spending differentials after qualifying CHF event for different cohorts**

Cohort definitions	Difference between nonadherent group and:			
	High-adherence group		Low-adherence group	
	Months 1-6	Months 7-12	Months 1-6	Months 7-12
All beneficiaries	-\$2,620*	-\$124	-\$2,270*	\$391*
Cohort variations:				
1: Exclude individuals who did not start on CHF medications	-3,539*	-675*	-3,019*	164
2: Include those who were on CHF medications before qualifying CHF event	-3,655*	-308*	-1,011*	211*
3: Include those with qualifying CHF event in outpatient and/or other carrier settings	-3,693*	-224	-3,687*	-481

Note: CHF (congestive heart failure). "Months 1-6" refers to the first six months after the qualifying congestive heart failure (CHF) event (outcome period 1), and "Months 7-12" refers to the second six months after the qualifying CHF event (outcome period 2).
*Denotes statistical significance at the 5 percent level.

Source: Acumen LLC analysis for MedPAC.

The first variation shown in Table 7-C1 excludes from the nonadherent group individuals who did not start on congestive heart failure (CHF) medications within six months of the qualifying CHF event. This variation is equivalent to defining the study cohort based on possession of study medication(s) during a specified time period. By excluding those who did not take any CHF medications, the nonadherent group consists only of individuals who filled at least one CHF medication within six months of the qualifying event (about 11 percent of all individuals originally assigned to the nonadherent group). For this group, the proportion of days covered averaged about 29.5 percent (compared with about 4 percent when including individuals who did not fill any CHF medications).

We found spending differentials were larger for both the high- and low-adherence groups when we excluded individuals with no CHF medication use (Table 7-C1). For example, relative to beneficiaries in the (redefined) nonadherent group, medical spending among beneficiaries in the high-adherence group during outcome period 1 was about \$3,500 less per month, on average, compared with about a \$2,600 differential estimated using the initial cohort (Table 7-C1). Medical spending among beneficiaries in the low-adherence group during outcome period 2 was \$164 higher compared with beneficiaries in the nonadherent group. However, unlike the result using the initial cohort, the estimate was no longer statistically significant.

It is somewhat counterintuitive to find larger effects when limiting the nonadherent group to those who initiated therapy. If the measured effects truly reflect the effects of taking CHF medications, this finding would imply that, at least for those in the nonadherent group, health outcomes were worse for those who started on CHF medications compared with those who did not. A more likely interpretation is that the larger estimated effects reflect the difference between the health statuses of the "nonadherent" beneficiaries who started on CHF medications after the qualifying CHF event compared with "nonadherent" beneficiaries who did not.

The second variation expands the cohort definition to include individuals who were on CHF medication(s) before their qualifying event. We excluded these individuals from our initial cohort to limit our analysis to those who were newly diagnosed with CHF during an inpatient event. These medications are commonly used to treat multiple conditions other than CHF. We hypothesized that including individuals who possessed CHF medications before the qualifying event would likely result in a wider variation in health status of individuals included in the study cohort, ranging from those with conditions that are precursors to CHF (e.g., hypertension) to those at a more progressed stage of the disease, compared with those who are newly diagnosed.

This change in the cohort definition primarily affected the adherent groups since the majority (over 90 percent) of the individuals who were already on CHF medications before the qualifying event continued to take at least one CHF medication after the event. The number of individuals included in the high- and low-adherence groups nearly quadrupled, while the number of individuals included in the nonadherent group increased by about 24 percent. Regardless of the level of adherence to CHF medications, unadjusted medical spending and use at baseline suggested that individuals who were treated with CHF medications before the event tended to have poorer health status compared with those in the initial cohort, with higher medical spending and higher incidence of illnesses, on average. In particular, the difference in medical spending between those with low adherence and those who were not adherent was much smaller in the expanded cohort compared with the initial cohort.

We found that spending differentials during outcome period 1 were larger for individuals with high adherence compared with the estimates for the initial cohort, while the opposite was true for those with low adherence. For example, the estimated spending differential for individuals with low adherence, using model specification 6, was \$1,011 when using this expanded cohort definition compared with \$2,270 for the initial cohort (Table 7-3 (see chapter text) and Table 7-C1).

The third variation expands the cohort to include individuals for whom the qualifying CHF event was in a noninpatient setting (i.e., an outpatient or other (carrier) setting such as a physician's office). This change increased

the number of beneficiaries in the adherent group (high- and low-adherence groups) by about 50 percent, while it nearly doubled the number of beneficiaries in the nonadherent group. Unadjusted medical spending during the first six months after the qualifying event suggested that those who started on CHF medications after a qualifying event in outpatient or other carrier settings may be somewhat healthier than those for whom the qualifying event was based on an inpatient claim. The opposite seemed to be true for beneficiaries who did not start on CHF medications after the qualifying event. For beneficiaries in the nonadherent group, the expansion of the cohort resulted in an increase in the average monthly spending by over \$1,300 (an increase of about 12 percent).

We found spending differentials were larger for both the high- and low-adherence groups when we included individuals for whom the qualifying CHF events were based on noninpatient claims (Table 7-C1). For example, relative to beneficiaries in the nonadherent group, medical spending among beneficiaries in the high-adherence group was \$3,693 less per month, on average, compared with the differential estimated using the original cohort definition (about \$2,600) during outcome period 1. Medical spending among beneficiaries in the low-adherence group was \$481 less per month compared with beneficiaries in the nonadherence group during outcome period 2. This result differs from the results we observed for other cohorts, where we found higher medical spending (though often not statistically significant) relative to spending by beneficiaries in the nonadherent group during outcome period 2. ■