The Impact of Electronic Health Records on Ambulatory Costs Among Medicaid Beneficiaries

Julia Adler-Milstein,[1] Claudia Salzberg,[2] Calvin Franz,[3] E. John Orav,[2] David Westfall Bates[2]
[1]University of Michigan
[2]Partners HealthCare
[3]Eastern Research Group

Supplement

Article doi: http://dx.doi.org/10.5600/mmrr.003.02.a03
Supplement doi: http://dx.doi.org/10.5600/mmrr.003.02.sa03

TECHNICAL APPENDIX:

I. Community Matching

For the purpose of the pilot, a community was defined as "a group of physician practices (primary care and specialty) that are closely affiliated with an acute-care hospital or several closely integrated acute-care hospitals in the community. "Closely affiliated" was defined to mean that the acute-care hospital(s) perform(s) a majority of the hospitalizations for patients seeing physicians in this community." http://www.maehc.org/documents/MAeHCRequestforApplications-6Dec04_000.pdf

Control Community Selection

We narrowed the list of applicant communities to communities as defined by Dartmouth Atlas and U.S. Census in order to use additional data for matching. In addition, the two Lowell pilot applications were treated as a single community as were the two Cambridge applications. Salem and Lynn submitted a combined application, but were treated as distinct communities. Boston was excluded because of uniqueness and multiple applications. The final number of communities available for matching was 20.

Variables for control community selection included: (1) population size and demographics (Census, 2000); (2) health care delivery infrastructure (data from pilot applications, Dartmouth Atlas, and FOLIO); (3) driving distance to Boston; (4) Medicare spending trends 2000–2005 (Dartmouth Atlas); and (5) level of EHR use and adoption

trajectory. For each measure, we calculated the standardized difference between each pilot community and potential control community. We then summed the standardized differences over all measures to calculate the aggregate difference between the pilot and control community. Values were doubled for a subset of measures to reflect their relative significance in determining the similarity of control communities to the pilot community. We selected the two control communities with the lowest aggregate distance for the given intervention community. Control communities were as follows: Brockton-South Weymouth-Taunton; Newburyport-Winchester-Lynn/Salem; North Adams-Pittsfield-Attleboro.

II. Provider Matching

We relied on National Provider Identifiers (NPIs) to assign providers to a particular community. In order to ensure that control community providers looked similar to intervention community providers we followed the following steps:

1. For intervention communities, NPIs were provided by MAeHC and we validated and supplemented them using the Medicare NPI database.
2. For control communities, we started with the list of all providers in the MassHealth provider directory with NPIs. These providers got assigned to a control community based on the ZIP Code of their practice location.
3. We then identified providers with NPIs who were located in one of the three intervention communities, but were NOT intervention providers.
    a. For each set of control communities, we eliminated any providers with characteristics that matched non-intervention providers in intervention communities (i.e., we eliminated Taunton and South Weymouth providers based on characteristics that absolutely differentiated Brockton intervention providers from Brockton non-intervention providers). For example, if there were no radiologists who were part of the pilot in Brockton, we removed radiologists from the two Brockton control communities.
    b. After we finished this step, we assessed the percent of intervention community providers remaining out of all providers in the intervention community (i.e., # of Brockton participants/total # of Brockton providers).
    c. We took the same percent of control providers from a list of probability score ranked control providers. Probability scores were derived from characteristics that did not absolutely differentiate intervention providers in intervention communities from non-intervention providers in intervention communities, but were more likely to be true of intervention providers. Mean probability scores for the three groups were as follows:
        i. Group 1: 0.90
        ii. Group 2: 0.78
        iii. Group 3: 0.94

ISSN: 2159-0354
doi: http://dx.doi.org/10.5600/mmrr.003.02.sa03

III. Outcome Measures

For each outcome measure, we report the definition used to select claims and calculate the measure, and for the subset of cost measures, we report the percent of claims, by year, which were assigned standardized costs. We then present summary statistics for all outcome measures (Exhibit 4).

Measure

Ambulatory medical spending per beneficiary per month.

Definition: Ambulatory Spending[1]

Claims that met the following definition were included in our measure:

1. clm_typ = 'B' AND serv_prv_typ (service provider type) value of 1-8, 16-17, 20, 50, 61, 75, 80, 81, 82, 97 OR
2. clm_typ = 'C' AND serv_prv_typ value of 20, 75, 80,81,82,97) OR
3. clm_type = 'M' AND serv_prv_typ value of 1-8, 16-17, 20, 50, 61, 80, 81 OR
4. clm_type = 'O' AND serv_prv_typ value of 75,80-82 AND
5. place_of_service is NOT equal to 21 (inpatient hospital) AND
6. cpt4 value holds a valid CPT code AND
7. serviceDate (Date of Service) value falls outside of a hospitalization period for that beneficiary (but can fall on the date of admission or discharge) and admit_dt = .

Applying Standardized Costs

We relied on the 2009 Physician Fee Schedule and followed the Medicare approach for calculating a standardized cost for each HCPCS/CPT code. We used the following GPCI values for Metropolitan Boston (carrier locality 3114301) in the formulas below:

- $GPCI_{WORK} = 1.1029$
- $GPCI_{PE} = 1.291$
- $GPCI_{MP} = 0.764$.
- CF (Conversion Factor) for FY 2009 = $36.0666

The following values are assigned based on the HCPCS/CPT code, and are available from CMS in the table RVU09D:

(1) Work RVU (W)
(2) Transitioned Non-Facility Physician Expenses (TNFPE)
(3) Fully Implemented Non-Facility Physician Expenses (FINFPE)
(4) Transitioned Facility Physician Expenses (TFPE)

[1]We worked with MassHealth to determine the best approach to identify ambulatory claims in the settings in which the pilot took place, using a combination of claim type and provider type.

ISSN: 2159-0354
doi: http://dx.doi.org/10.5600/mmrr.003.02.sa03

(5) Fully Implemented Facility Physician Expenses (FIFPE)
(6) Malpractice RVU (MP)

Cost Calculation

(1) Non-Facility cost:
$[W^{*}GPCI_{WORK} + FINFPE^{*}GPCI_{PE} + MP^{*}GPCI_{MP}]^{*}CF$

(2) Facility cost:
$[W^{*}GPCI_{WORK} + FIFPE^{*}GPCI_{PE} + MP^{*}GPCI_{MP}]^{*}CF$

We then applied a cost, based on the calculations above, to each claim based on the HCPCS/CPT and place of service. To help ensure that claims missing cost assignments would not bias our results, we confirmed that approximately the same percent of claims were assigned costs each year (Exhibit 1). Claims were missing costs when Medicare did not reimburse for the given service and therefore did not include it in their fee schedule.

Exhibit 1

Year	Match %
2005	91.0
2006	91.1
2007	91.4
2008	91.8
2009	91.3

SOURCE: Authors' analysis.

Measure

Ambulatory laboratory spending per beneficiary per month.

Summary of Approach

This definition extracts claims that encode ambulatory laboratory services (including pathology). They are a subset of the claims used to create the ambulatory spending measure.

Definition: Ambulatory Laboratory Spending

1. clm_typ = 'B' AND serv_prv_typ (service provider type) value of 1-8, 16-17, 20, 50, 61, 75, 80, 81, 82, 97 OR
2. clm_typ = 'C' AND serv_prv_typ value of 20, 75, 80,81,82,97) OR
3. clm_type = 'M' AND serv_prv_typ value of 1-8, 16-17, 20, 50, 61, 80, 81 OR
4. clm_type = 'O' AND serv_prv_typ value of 75,80-82 AND

ISSN: 2159-0354
doi: http://dx.doi.org/10.5600/mmrr.003.02.sa03

5. cpt4 value is between a subset of 80047 and 89356 (Lab and Path)[2] AND
6. CLM_STAT = 'PAY' (claim was paid) AND
7. place_of_service is NOT equal to 21 (inpatient hospital) AND
8. serviceDate (Date of Service) value falls outside a hospitalization period for that beneficiary (but can fall on the date of admission or discharge)

OR

1. clm_typ = 'B' AND serv_prv_typ (service provider type) value of 1-8, 16-17, 20, 50, 61, 75, 80, 81, 82, 97 OR
2. clm_typ = 'C' AND serv_prv_typ value of 20, 75, 80,81,82,97) OR
3. clm_type = 'M' AND serv_prv_typ value of 1-8, 16-17, 20, 50, 61, 80, 81 OR
4. clm_type = 'O' AND serv_prv_typ value of 75,80-82 AND
5. cpt4 value follows GXXXX format[3] AND
6. CLM_STAT = 'PAY' (claim was paid) AND
7. place_of_service is NOT equal to 21 (inpatient hospital) AND
8. cpt4 value holds a valid CPT code AND
9. serviceDate (Date of Service) value falls outside a hospitalization period for that beneficiary (but can fall on the date of admission or discharge)

Applying Standardized Costs

We applied a cost to each claim based on the Physician Fee Schedule (see above). To help ensure that claims missing cost assignments would not bias our results, we confirmed that approximately the same percent of claims were assigned costs each year (Exhibit 2).

Exhibit 2

Year	Match %
2005	90.6
2006	90.6
2007	91.0
2008	91.4
2009	92.1

SOURCE: Authors' analysis.

Measure

Ambulatory radiology spending per beneficiary per month.

[2]There are laboratory codes that fall outside the range included in our definitions, because they are typically performed in conjunction with another procedure (i.e., a surgery). These are excluded from this definition (due to the difficulty in identifying the codes and low likelihood that they would be affected by the intervention since they accompany other procedures). They are, however, included in the ambulatory spending measure.

[3]We decided to exclude "S" codes, because they are temporary.

ISSN: 2159-0354
doi: http://dx.doi.org/10.5600/mmrr.003.02.sa03

Summary of Approach

This definition extracts claims that encode as ambulatory radiology services. They are a subset of the claims used to create the ambulatory spending measure.

Definition: Ambulatory Radiology Spending

1. clm_typ = 'B' AND serv_prv_typ (service provider type) value of 1-8, 16-17, 20, 50, 61, 75, 80, 81, 82, 97 OR
2. clm_typ = 'C' AND serv_prv_typ value of 20, 75, 80,81,82,97) OR
3. clm_type = 'M' AND serv_prv_typ value of 1-8, 16-17, 20, 50, 61, 80, 81 OR
4. clm_type = 'O' AND serv_prv_typ value of 75,80-82 AND
5. cpt4 value is between 70010 and 79999 (Radiology)[4] AND
6. CLM_STAT = 'PAY' (claim was paid) AND
7. place_of_service is NOT equal to 21 (inpatient hospital) AND
8. serviceDate (Date of Service) value falls outside a hospitalization period for that beneficiary (but can fall on the date of admission or discharge)

Applying Standardized Costs

We applied a cost to each claim based on the Physician Fee Schedule (see above). To help ensure that claims missing cost assignments would not bias our results, we confirmed that approximately the same percent of claims were assigned costs each year (Exhibit 3).

Exhibit 3

Year	Match %
2005	99.9
2006	99.9
2007	99.9
2008	100
2009	100

SOURCE: Authors' analysis.

Measure

Number of ambulatory visits per beneficiary per month.

Summary of Approach

This definition extracts claims that define two types of ambulatory visits that take place in the office or other outpatient setting. Option A is limited to visits that include Evaluation &

[4]There are radiology codes that fall outside this range, because they are typically performed in conjunction with another procedure (i.e., a surgery). These are excluded from this definition (due to the difficulty in identifying the codes and low likelihood that they would be affected by the intervention since they accompany other procedures). They are however included in the ambulatory spending measure.

ISSN: 2159-0354
doi: http://dx.doi.org/10.5600/mmrr.003.02.sa03

Management and Option B includes visits for a broader set of services. These two options are defined based on the CPT-4 range they select. Claims for the same beneficiary performed by the same servicing provider on the same date are counted as a single visit.

Definition: Ambulatory Visits

Option A:

1. clm_typ = 'B' AND serv_prv_typ (service provider type) value of 1-8, 16-17, 20, 50, 61, 75, 80, 81, 82, 97 OR
2. clm_typ = 'C' AND serv_prv_typ value of 20, 75, 80,81,82,97) OR
3. clm_type = 'M' AND serv_prv_typ value of 1-8, 16-17, 20, 50, 61, 80, 81 OR
4. clm_type = 'O' AND serv_prv_typ value of 75,80-82 AND
5. cpt4 value in the 99201 – 99607 range excluding ER CODES (99281-99284) AND
6. place_of_service is NOT equal to 21 (inpatient hospital) AND
7. CLM_STAT = 'PAY' (claim was paid) AND
8. serviceDate value does not fall within a hospitalization period (but can fall on admission or discharge days).
9. Multiple claims meeting above criteria with same servicing provider number on same service date are only counted as a single visit.

Option B:

1. clm_typ = 'B' AND serv_prv_typ (service provider type) value of 1-8, 16-17, 20, 50, 61, 75, 80, 81, 82, 97 OR
2. clm_typ = 'C' AND serv_prv_typ value of 20, 75, 80,81,82,97) OR
3. clm_type = 'M' AND serv_prv_typ value of 1-8, 16-17, 20, 50, 61, 80, 81 OR
4. clm_type = 'O' AND serv_prv_typ value of 75,80-82 AND
5. cpt4 value in the 10021-69990 OR 90281 – 99607 range excluding ER CODES (99281-99284) AND
6. place_of_service is NOT equal to 21 (inpatient hospital) AND
7. CLM_STAT = 'PAY' (claim was paid) AND
8. serviceDate value does not fall within a hospitalization period (but can fall on admission or discharge days).
9. Multiple claims meeting above criteria with same servicing provider on same service date are only counted as a single visit.

ISSN: 2159-0354
doi: http://dx.doi.org/10.5600/mmrr.003.02.sa03

Exhibit 4. Summary Statistics

Measure	Percent of member months with non-zero value	Mean	Median	Standard Deviation	Minimum	Maximum
Ambulatory Medical Cost	43%	$147	$0	$420	$0	$20,816
Ambulatory Laboratory Cost	6%	$5	$0	$36	$0	$4,740
Ambulatory Radiology Cost	12%	$35	$0	$174	$0	$8,946
Ambulatory Visits	39%	1.09	0	2.67	0	153
Ambulatory Evaluation and Management Visits	33%	0.64	0	1.69	0	132

SOURCE: Authors' analysis.

IV. Analytic Model

Our model took the following general form:

$$y_{ip} = \beta_0 + \beta_1 Int + \beta_2 T_p + \beta_3 T_p Int + \beta_4 I_{B1}(T_{p>0}) + \beta_5 I_{B1}(T_{p>0}) Int + \beta_6 I_{B2}(T_{p>21}) + \beta_7 I_{B2}(T_{p>21}) Int + \sum_{j=12}^{J^*} \beta_j x_{ijp} + \sum_{j=J^*}^{J} \beta_j x_{ij} + \mu_{ip}$$

y_{ip} represents the outcome of interest for beneficiary i in month p. We did not require that beneficiaries be continuously insured over the entire period of interest and, therefore, beneficiaries may be included for a single month if they were only covered for that month or up to the full 48 months of the study.

The time-series variables included in the model are as follows:

β_0 represents the intercept of the regression for the pre-implementation period for the control group.

Int is a dichotomous variable coded 0 for beneficiaries in the control community and 1 for beneficiaries in the intervention community; β_1 captures the change in intercept for the intervention versus control beneficiaries at the start of the pre-implementation period.

T_p is a time counter that runs from -8 (July 2005) to 39 (June 2009); β_2 captures the slope for the control group.

T_p (Int) is an interaction of T_p and Int such that for the control group all values are zero; for the intervention group values count up from -8 (July 2005) to 39 (June 2009) for the entire period; β_3 captures the difference in slope for the intervention group relative to the control group.

$I_{B1}(T_{p>0})$ is an interaction of I_{B1} and T_p such that all values are zero prior to the start of implementation and then count up from 1 to 39; β_4 captures the change in slope from the pre-implementation period to the intervention period for the control group.

$I_{B1}(T_{p>0})$(Int) is a three way interaction between I_{B1}, T_p and Int such that for the control group all values are zero and for the intervention group, values are zero in the pre-implementation period and then count up from 1 to 39; β_5 captures the difference in slope from the pre-

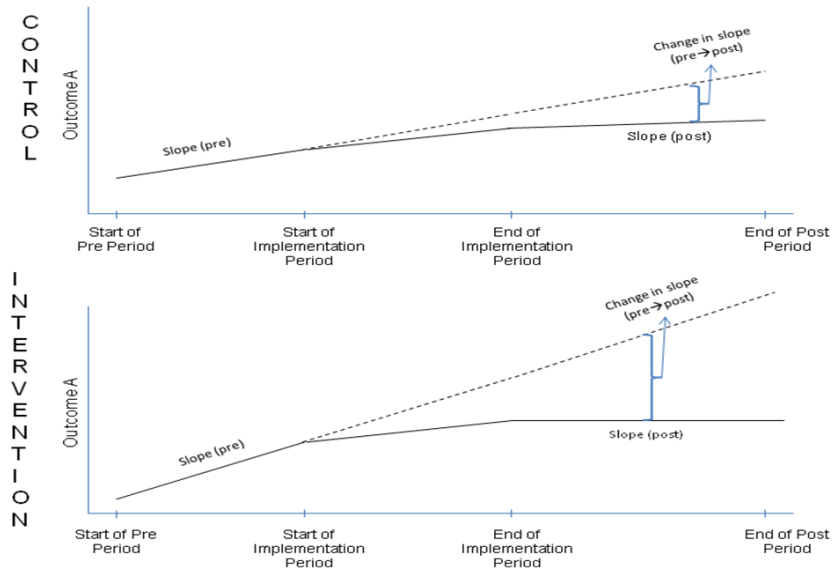
implementation period to the implementation period for the intervention group relative to the control group.

$I_{B2}(T_{p>21})$ is an interaction of I_{B2} and T_p such that all values are zero prior to the start of post-implementation and then count up from 1 to 18; β_6 captures the change in slope from the implementation period to the post- implementation period for the control group.

$I_{B2}(T_{p>21})(Int)$ is a three way interaction between I_{B2}, T_p and Int such that for the control group all values are zero and for the intervention group, values are zero in the pre-implementation/implementation periods, and count up from 1 to 18 in the post-implementation period; β_7 captures the difference in slope from the implementation period to the post-implementation period for the intervention group relative to the control group.

We test whether the change between the pre-to-post slope for the control group (β_2 compared to $\beta_2 + \beta_4 + \beta_6$) is statistically different from the change between the pre-to-post slope for the intervention group ($\beta_2 + \beta_3$ compared to $\beta_2 + \beta_3 + \beta_4 + \beta_5 + \beta_6 + \beta_7$). See Exhibit 5 below for a visual depiction.

Exhibit 5



SOURCE: Authors' analysis.

ISSN: 2159-0354
doi: http://dx.doi.org/10.5600/mmrr.003.02.sa03

Medicare & Medicaid Research Review
2013
Volume 3, Number 2

Mission Statement

Medicare & Medicaid Research Review is a peer-reviewed, online journal reporting data and research that informs current and future directions of the Medicare, Medicaid, and Children's Health Insurance programs. The journal seeks to examine and evaluate health care coverage, quality and access to care for beneficiaries, and payment for health services.

http://www.cms.gov/MMRR/

Contact: mmrr-editors@cms.hhs.gov

Published by the Centers for Medicare & Medicaid Services

ISSN: 2159-0354
doi: http://dx.doi.org/10.5600/mmrr.003.02.sa03