Biopsy Procedures and Molecular Testing Utilization and Related Costs in Patients with Metastatic Lung Cancer

Reshma Shinde, MBBS, MPH; Xiting Cao, PhD; and Smita Kothari, PhD, MBA, RPh

ABSTRACT

BACKGROUND: Epidermal growth factor receptor (*EGFR*) gene mutations and anaplastic lymphoma kinase (*ALK*) gene rearrangements are key therapeutic targets for biomarker-driven treatment with an *EGFR* or *ALK* tyrosine kinase inhibitor (TKI) in patients with metastatic non-small cell lung cancer (NSCLC). To appropriately guide treatment decisions, since 2011, the National Comprehensive Cancer Network and the American Society of Clinical Oncology therefore recommend *EGFR* and *ALK* analysis in tumor samples obtained at the time of diagnosis in patients with non-squamous NSCLC. Currently, there are limited data on utilization patterns and cost of biopsy procedures and biomarker tests in patients with metastatic NSCLC who receive an *EGFR* or *ALK* TKI.

OBJECTIVES: To (a) describe utilization patterns and costs associated with biopsy procedures and biomarker testing in patients with NSCLC who received erlotinib or crizotinib between 2009 and 2012 and (b) investigate the timing of these procedures relative to the erlotinib or crizotinib index date.

METHODS: Adult patients with metastatic lung cancer were identified by ICD-9-CM diagnostic codes within the Truven Health Analytic MarketScan database. Patients were included in the analysis if they had an index erlotinib or crizotinib claim between January 1, 2009, and September 30, 2012 (index period) and were continuously enrolled for ≥ 12 months before the index claim. Because there is no specific ICD-9-CM diagnostic code for NSCLC, patients with metastatic lung cancer who received erlotinib or crizotinib were considered to have metastatic NSCLC. Using CPT and ICD-9-CM codes, lung biopsy procedures performed during the 24 months before or 12 months after the index claim date were identified. For every patient, biomarker testing claims for *EGFR* and *ALK* were identified using the molecular pathology stacked CPT code during the 2 months before or 1 month after the index date. The frequency of claims for biopsy procedures and biomarker testing was analyzed descriptively. The overall summary measures for biomarker testing, especially frequency of *EGFR* testing in patients receiving erlotinib, was also described as before and after 2011, the year when biomarker testing became part of the guidelines. Per patient and overall costs for biopsy procedures and biomarker testing were calculated from payer and patient perspectives.

RESULTS: Of the 4,926 identified patients, 4,801 (97.5%) received erlotinib, and 125 (2.5%) received crizotinib. Biopsy procedure claims were identified for 3,579 (72.7%) patients, including 3,503 (73.0%) erlotinib recipients and 76 (60.8%) crizotinib recipients. Biomarker testing claims were identified for 675 (13.7%) patients, including 634 (13.2%) erlotinib recipients and 41 (32.8%) crizotinib recipients. Overall, most biomarker testing procedures (476 of 741) were identified in 435 (of 675) patients after year 2011. Also, among erlotinib recipients, percentage of patients receiving *EGFR* testing was increased over the index period. Per patient mean (SD) numbers of biopsy procedures and biomarker tests were 1.2 (1.1) and 0.2 (0.4), respectively. In the outpatient setting, per patient mean (SD) cost per biopsy procedure was \$1,223 (\$1,899) from the payer perspective and \$60 (\$147) from the patient perspective, whereas in the inpatient setting, it was \$8,163 (\$18,712) and \$180 (\$691), respectively. Among patients receiving at least 1 biomarker test, the per patient mean (SD) cost for the overall population was \$891 (\$1,062) and

\$43 (\$229); for erlotinib recipients, it was \$906 (\$1,084) and \$42 (\$228); and for crizotinib recipients, it was \$664 (\$576) and \$55 (\$243) in payer and patient perspectives, respectively.

CONCLUSIONS: This study provides insight into the use and cost of biopsy and biomarker testing procedures in patients with metastatic NSCLC. The low frequency of biomarker testing highlights the need for more awareness of testing to guide treatment decisions in these patients. Costs associated with biopsy procedures and biomarker testing provide insight into the economic impact on metastatic NSCLC patients treated with targeted therapy.

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What is already known about this subject

- Epidermal growth factor receptor (*EGFR*) gene mutations and anaplastic lymphoma kinase (*ALK*) gene rearrangements have become key therapeutic targets for biomarker-driven treatment in patients with advanced/metastatic non-small cell lung cancer (NSCLC) of non-squamous etiology.
- Guidelines recommend *EGFR* and *ALK* biomarker testing to identify patients eligible for erlotinib and crizotinib therapy.
- There is a lack of information on the use and cost of biopsy procedures and biomarker testing.

What this study adds

- This retrospective claims database analysis study provided information on the utilization patterns of and costs associated with biopsy procedures and biomarker testing in patients with advanced lung cancer who received erlotinib or crizotinib.
- Despite guideline recommendations, the frequency of biomarker testing after year 2011 is low.
- The costs for biopsy sample collection and biomarker testing varied considerably, providing insight into the economic impact of these procedures in the management of patients with metastatic NSCLC who receive biomarker-driven therapies.

Tremendous advances in lung cancer biology over the past decade have paved the way for targeted therapy in patients with advanced non-small cell lung cancer (NSCLC).¹ Mutations in the epidermal growth factor receptor (*EGFR*) gene and rearrangements of the anaplastic lymphoma kinase (*ALK*) gene have become key therapeutic targets for biomarker-driven treatment in patients with non-squamous NSCLC.²

Nearly 90% of *EGFR* mutations manifest as either deletions in exon 19 or substitutions in exon 21 (L858R); both of these *EGFR* mutations confer increased sensitivity to tyrosine kinase inhibitors (TKIs) that target the intracellular tyrosine kinase domain.³ Fusion of the echinoderm microtubule-associated protein-like-4 (*EML4*) and *ALK* genes is associated with lung adenocarcinomas lacking *EGFR* mutations and is correlated with *ALK* expression.⁴ In the United States, prevalence of *EGFR* mutations is 10%-15%, and *ALK* rearrangements are 2%-7%, depending on the population studied and the detection method used.⁵⁻⁹

Randomized controlled trials comparing *EGFR* TKIs to chemotherapy in first-line *EGFR* mutation-positive NSCLC patients have demonstrated a significant progression-free survival (PFS; range=9.2-13.1 months; hazard ratio range=0.16-0.48) and response rates ranging from 61%-83%.¹⁰⁻¹² Based on these results, where sensitizing *EGFR* mutations predicted better response and PFS in patients with NSCLC,^{10,12-16} in 2011, the National Comprehensive Cancer Network (NCCN) and American Society of Clinical Oncology (ASCO) recommended *EGFR* analysis in tumor samples collected at the time of non-squamous NSCLC diagnosis before administration of erlotinib.^{17,18} After further approval of crizotinib in August 2011, NCCN recommended *ALK* analysis as well.¹⁹ In 2013, the College of American Pathologists, the International Association for the Study of Lung Cancer, and the Association for Molecular Pathology also recommended *EGFR* and *ALK* testing for selection of lung cancer patients for *EGFR* and *ALK* TKIs.²⁰ Compared with chemotherapy, these therapies have shown better quality of life and improvement in symptoms in the clinical trial setting^{21,22} and in clinical practice.²³ A recent analysis also suggested that biomarker testing for *EGFR* mutations and *ALK* overexpression and biomarker conditional treatment is a cost-effective strategy compared with treatment with chemotherapy and no testing in metastatic NSCLC.²⁴

Currently, there is a lack of information on utilization patterns of biopsy procedures and biomarker testing in NSCLC. This information is necessary to gain insight into the treatment patterns of targeted therapies as more and more similar therapies are becoming available. Since NSCLC treatment decisions are now based on a complex algorithm in which histology and biomarkers are important factors, a multidisciplinary approach to NSCLC management is imperative.^{25,26} Such a multidisciplinary approach means that it is important to understand the type of provider associated with these procedures, the settings of care (inpatient and outpatient), and the types of visits.

It is also crucial to explore costs associated with biopsy and biomarker testing procedures, as expanding use of targeted therapies necessitates increased use of these procedures, which may affect health care costs.²⁷ An analysis conducted using integrated medical and pharmaceutical data from 4 Blue Cross Blue Shield plans showed a wide variation observed in per patient cost for *EGFR* testing. From a payer perspective,

the plan-paid cost for *EGFR* testing ranged from \$5 to \$732.²⁸ However, details were lacking, particularly for patient out-of-pocket costs for biomarker testing and for biopsy procedures.

The purpose of this study was to describe the use and costs of biopsy and biomarker testing procedures in patients with NSCLC who received erlotinib or crizotinib and to investigate the timing of these procedures relative to the erlotinib or crizotinib index date.

Methods

This descriptive, retrospective cohort study was conducted using the Commercial Claims and Encounters and Medicare Supplemental databases within the Truven Health Analytic MarketScan Research Databases. The MarketScan databases represent the medical experience of insured employees and their dependents for active employees, early retirees, COBRA continuers, and Medicare-eligible retirees with employer-provided Medicare Supplemental plans and represents over 77 million patients since 1996. It captures person-specific clinical utilization, expenditures, and enrollment across inpatient, outpatient, prescription drug, and carve-out services from a selection of large employers, health plans, and government and public organizations. The Commercial Claims and Encounters Database captures individuals insured by employer-sponsored plans (i.e., non-Medicare-eligible), and Medicare Supplemental Database captures Medicare-eligible retirees with employer-sponsored Medicare Supplemental plans, which predominantly contains fee-for-service plan data.

Identification of Patients Receiving Erlotinib or Crizotinib

The study period spanned from January 1, 2007, to September 30, 2013. The index period was January 1, 2009, through September 30, 2012. Patients were included in the study if they were aged ≥ 18 years; had ≥ 1 *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) diagnosis code at the primary and/or secondary position for metastatic lung cancer (162.2-162.5, 162.8-162.9) during the study period; had an index pharmacy claim for erlotinib or crizotinib identified by National Drug Code numbers (54868-5290, 54868-5447, 54868-5474, 50242-062, 50242-063, or 50242-064 for erlotinib; 0069-8140 or 0069-8141 for crizotinib) during the index period with no other erlotinib or crizotinib pharmacy claim in the previous 180 days; and had a continuous enrollment for ≥ 12 months before the index date (i.e., the date of the first pharmacy claim for erlotinib or crizotinib identified during the index period). Since the ICD-9-CM classification system does not provide separate diagnosis codes for NSCLC, in this study, patients with metastatic lung cancer who received erlotinib or crizotinib were assumed to have NSCLC, since these therapies are indicated exclusively for treatment of NSCLC. Patients were further categorized as newly diagnosed or previously diagnosed. Patients were defined as

FIGURE 1 Patient Selection Flow

ICD-9-CM = International Classification of Diseases, Ninth Revision, Clinical Modification; NDC = National Drug Code.

newly diagnosed if they had no identifiable ICD-9-CM code for lung cancer in 1 year before the first ICD-9-CM lung cancer code identified in the index period; others were defined as previously diagnosed.

Biopsy Procedures and Biomarker Testing Identification

Lung biopsy procedures performed at least up to 12 months and until 24 months before and 12 months after the index date were identified by Current Procedural Terminology (CPT) and/or ICD-9-CM procedure codes (Appendix A, available in online article). All CPT codes of the same biopsy type on the same day were considered to be related to the same biopsy procedure. Nonbiopsy-specific CPT codes for guided needle placement were considered to be associated with biopsy procedure only when they were identified on the same day as the biopsy-related CPT code. For inpatient admission claims, all claims with the biopsy procedure code as the primary procedure under the same diagnosis-related group code were considered to be associated with the same biopsy procedure. CPT codes for ancillary biopsy procedures were also identified. For all lung biopsy procedures, information on the type of biopsy, provider, facility where the biopsy was performed, and the type of visit (i.e., inpatient, outpatient, or emergency room) was identified.

During a period of 2 months before and 1 month after the index date, biomarker testing for *EGFR* and *ALK* was identified by using CPT codes classified as molecular pathology stacking codes (83890-83914) or array codes (88384-88386; Appendices B and C, available in online article). These CPT codes are a series of codes representing individual steps or techniques used in performing a test. Although these codes were discontinued as of January 2013, they were considered to be appropriate for this study, since the biomarker testing identification period ranged from November 1, 2008, to October 30, 2012. During the biomarker testing identification period,

there was no specific identification code for *EGFR* and *ALK*; therefore, it was assumed that testing conducted in patients receiving erlotinib was for *EGFR*, and testing conducted in patients receiving crizotinib was for *ALK*. All biomarker testing-related CPT codes with the same date were identified as related to the same test and were considered to be part of the same pathology code stack. For all biomarker testing, information on the location of testing was also identified.

Biopsy Procedure and Biomarker Testing Cost Identification

Costs associated with lung biopsy procedures and biomarker testing were estimated from payer and patient perspectives. Payer costs included the net payment made by the payer toward the biopsy procedure or biomarker test; patient costs included the amount paid by the patient, which collectively included the amount paid as copayment, coinsurance, and/or deductible. Costs were described by the type of facility (inpatient or outpatient). Costs of biopsy procedures and biomarker testing were calculated based on the associated CPT codes previously described. For biopsy procedures, costs associated with accompanying ancillary procedures were also taken into account and contributed to the final cost. For biomarker testing, costs for interpretation and reporting were also taken into account. All costs were adjusted to April 2016, based on the Consumer Price Index.

Statistical Analyses

All study variables, including baseline characteristics and frequency of biopsy procedures and biomarker testing, were analyzed using descriptive statistics. The overall summary measures for biomarker testing and for patients receiving erlotinib, especially frequency of *EGFR* testing, was described before and after 2011, the year when biomarker testing became part of the guidelines.

TABLE 1 Patient Baseline Characteristics

Characteristic	Total Population N = 4,926	Erlotinib Recipients n = 4,801			Crizotinib Recipients n = 125		
		All Patients	Previously Diagnosed Patients (n = 1,182)	Newly Diagnosed Patients (n = 3,619)	All Patients	Previously Diagnosed Patients (n = 4)	Newly Diagnosed Patients (n = 121)
Mean age at index date (SD), years	67 (11.6)	67 (11.5)	67.5 (10.8)	67.1 (11.7)	55 (11.4)	58.5 (11.1)	55.3 (11.5)
Sex, n (%)							
Male	2,326 (47.2)	2,274 (47.4)	564 (47.7)	1,710 (47.3)	52 (41.6)	2 (50.0)	50 (41.3)
Female	2,600 (52.8)	2,527 (52.6)	618 (52.3)	1,909 (52.8)	73 (58.4)	2 (50.0)	71 (58.7)
Age group at index date, n (%)							
18-34 years	20 (0.4)	13 (0.3)	3 (0.3)	10 (0.3)	7 (5.6)	0 (0.0)	7 (5.8)
35-44 years	80 (1.6)	67 (1.4)	12 (1.0)	55 (1.5)	13 (10.4)	1 (25.0)	12 (10.0)
45-54 years	599 (12.2)	565 (11.8)	111 (9.4)	454 (12.5)	34 (27.2)	0 (0.0)	34 (28.1)
55-64 years	1,591 (32.3)	1,540 (32.1)	375 (31.8)	1,165 (32.2)	51 (40.8)	1 (25.0)	50 (41.3)
≥65 years	2,636 (53.5)	2,616 (54.5)	681 (57.0)	1,935 (53.5)	20 (16.0)	2 (50.0)	18 (14.9)
Year of index date, n (%)							
2009	1,300 (26.4)	1,300 (27.1)	817 (69.1)	483 (13.4)	0 (0.0)	0 (0.0)	0 (0.0)
2010	1,237 (25.1)	1,237 (25.8)	230 (19.5)	1,007 (27.8)	0 (0.0)	0 (0.0)	0 (0.0)
2011	1,405 (28.5)	1,357 (28.3)	92 (7.8)	1,265 (35.0)	48 (38.4)	1 (25.0)	47 (38.8)
2012	984 (20.0)	907 (18.9)	43 (3.6)	864 (23.9)	77 (61.6)	3 (75.0)	74 (61.2)
Type of insurance, n (%)							
EPO	32 (0.7)	29 (0.6)	2 (0.2)	27 (0.8)	3 (2.4)	0 (0.0)	3 (2.5)
HMO	657 (13.3)	637 (13.3)	133 (11.3)	504 (13.9)	20 (16.0)	2 (50.0)	18 (14.9)
POS	272 (5.5)	264 (5.5)	69 (5.8)	195 (5.4)	8 (6.4)	0 (0.0)	8 (6.6)
PPO	2,251 (45.7)	2,175 (45.3)	583 (49.3)	1,592 (44.0)	76 (60.8)	2 (50.0)	74 (61.2)
Other	1,714 (34.8)	1,696 (35.3)	395 (33.4)	1,301 (36.0)	18 (14.4)	0 (0.0)	18 (14.9)

EPO=exclusive provider organization; HMO=health maintenance organization; POS=point of service; PPO=preferred provider organization; SD=standard deviation.

Costs of biopsy procedures were calculated separately for the inpatient and outpatient settings, with summary statistics of net payment by payer and copayment by patients, including coinsurance and/deductibles, presented for the overall cohort. Costs of biomarker testing were calculated similarly without differentiating the setting of the test.

Statistical analyses were conducted using SAS software, version 9.2 (SAS Institute, Cary, NC).

Results

After applying the eligibility criteria, 4,926 patients with metastatic lung cancer who received erlotinib or crizotinib during the index period were identified. Of these, 4,801 (97.5%) received erlotinib, and 125 (2.5%) received crizotinib (Figure 1). Among erlotinib and crizotinib recipients, biopsy procedure claims were identified in 3,503 (73.0%) and 76 (60.8%) patients, respectively. Mean (standard deviation [SD]) number of biopsy procedures was 1.2 (1.1) for the total population. Biomarker testing claims were identified in 634 (13.2%) erlotinib and 41 (32.8%) crizotinib recipients. Overall mean (SD) number of testing procedures was 0.2 (0.4), and it was 0.1 (0.3) after 2011 in the total population.

Patient baseline characteristics are summarized in Table 1 for the total population and for erlotinib and crizotinib recipients. Overall, 2,600 (52.8%) patients were female, and mean (SD) age at index date was 67 (11.6) years. Study population was evenly distributed throughout the study period except in 2012 because of the early cut-off date. Preferred provider organization plans covered almost half of the study population (n=2,251, 45.7%). The majority of patients (n=3,740, 76%) were newly diagnosed. Crizotinib recipients, of whom 121 (96.8%) were newly diagnosed, were more likely to start therapy in 2012.

Table 2 describes the characteristics and frequency of biopsy procedures. A total of 5,730 biopsy procedures were identified in 3,579 (72.7%) patients. Of all procedures, 4,393 (76.7%) were performed in newly diagnosed patients. Among those patients who received ≥1 biopsy procedure, 2,143 (59.9%) had only 1 procedure. Samples were most commonly collected by bronchial biopsy (n=3,183, 55.6%) followed by percutaneous biopsy (n=1,750, 30.5%). Most biopsy procedures were performed at outpatient visits (n=4,200, 73.3%). The facility where the biopsy was performed was unknown for 57.7% of biopsy procedures because of incomplete data. Of the 2,426 biopsies for which the type of facility was known, the majority

TABLE 2 Summary of Biopsy Procedures

	Total Population (N = 4,926)	Previously Diagnosed Patients (n = 1,186)	Newly Diagnosed Patients (n = 3,740)
Received a biopsy procedure, n (%)	3,579 (72.7)	800 (67.4)	2,779 (74.3)
Erlotinib recipients	3,503	798	2,705
Crizotinib recipients	76	2	74
Number of biopsy procedures per patient, mean (SD)	1.2 (1.1)	1.1 (1.6)	1.17 (1.0)
Erlotinib recipients	1.17 (1.1)	1.1 (1.6)	1.18 (1.0)
Crizotinib recipients	1.02 (1.1)	0.5 (0.6)	1.04 (1.1)
Description of biopsy procedures			
Total biopsy procedures, n	5,730	1,337	4,393
Erlotinib recipients	5,602	1,335	4,267
Crizotinib recipients	128	2	126
Biopsy procedures per patient, n (%)			
0	1,347 (27.3)	386 (32.6)	961 (25.7)
1	2,143 (43.5)	464 (39.1)	1,679 (44.9)
2	932 (18.9)	205 (17.3)	727 (19.4)
3	360 (7.3)	91 (7.7)	269 (7.2)
≥ 4	144 (2.9)	40 (3.4)	104 (2.8)
Type of biopsy procedure, n (%)			
Bronchial	3,183 (55.6)	742 (62.6)	2,441 (65.3)
Percutaneous	1,750 (30.5)	403 (34.0)	1,347 (36.0)
Fine needle	690 (12)	166 (14.0)	524 (14.0)
Surgical	36 (0.6)	11 (1.0)	25 (0.7)
Other	71 (1.2)	15 (1.3)	56 (1.5)
Type of visit for biopsy procedure, n (%)			
Outpatient	4,200 (73.3)	1,040 (87.7)	3,160 (84.5)
Inpatient	1,299 (22.7)	252 (21.3)	1,047 (28.0)
Emergency department	10 (0.2)	0	10 (0.3)
Other	221 (3.9)	45 (3.8)	176 (4.7)
Location of biopsy procedure, n (%)			
Acute care hospital	2,189 (38.2)	467 (39.4)	1,722 (46.0)
Ambulatory surgery center	50 (0.9)	14 (1.2)	36 (1.0)
Urgent care facility	3 (0.1)	1 (0.1)	2 (0.1)
Other	184 (3.2)	54 (4.6)	130 (3.5)
Unknown	3,304 (57.7)	801 (67.5)	2,503 (66.9)
Type of provider associated with biopsy procedure, n (%)			
Radiologist	2,108 (36.8)	446 (37.6)	1,662 (44.4)
Pulmonologist	1,071 (18.7)	243 (20.5)	828 (22.1)
Physician (family practice/internal medicine)	786 (13.7)	195 (16.4)	591 (15.8)
Pathologist	547 (9.6)	111 (9.4)	436 (11.7)
Surgeon (thoracic, general, or cardiothoracic)	227 (4.0)	60 (5.1)	167 (4.5)
Other	548 (9.6)	142 (12.0)	406 (10.9)
Unknown	443 (7.7)	140 (11.8)	303 (8.1)

SD = standard deviation.

(n = 2,189, 90.2%) were performed in an acute care hospital. Among the personnel performing the biopsy procedures, radiologists (n = 2,120, 36.8%) were the most common, followed by pulmonologists (n = 1,076, 18.8%), physicians (n = 923, 16.1%), and pathologists (n = 372, 6.5%).

Table 3 describes the summary of biomarker testing procedures. A total of 741 biomarker testing procedures were identified in 675 (13.7%) patients, with 654 and 87 performed

in newly and previously diagnosed patients, respectively. Among those patients who received biomarker testing, 614 (91%) had ≥ 1 test. Overall, most biomarker testing procedures (476 of 741) were identified in 435 (of 675) patients after 2011. Frequency of patients receiving *EGFR* testing increased over the index period with more than 60% of the procedures occurring after 2011 (except for 2012 because of limits on the study period). Most biomarker tests were performed at either

TABLE 3 Summary of Biomarker Testing Procedures

	All Patients (N = 4,926)	Previously Diagnosed Patients (n = 1,186)	Newly Diagnosed Patients (n = 3,740)
Overall population			
Patients receiving biomarker testing, n	675	80	595
Before 2011	240	62	178
After 2011	435	18	417
Biomarker testing procedures, n	741	87	654
Before 2011	265	67	198
After 2011	476	20	456
Mean number of biomarker testing procedures per patient (SD)	0.2 (0.4)	0.1 (0.3)	0.2 (0.4)
Before 2011	0.05 (0.3)	0.06 (0.3)	0.05 (0.3)
After 2011	0.10 (0.3)	0.02 (0.1)	0.12 (0.4)
Total biomarker testing procedures per patient, n (%)			
0	4,251 (86.3)	1,150 (93.3)	3,101 (84)
1	614 (12.5)	75 (6.1)	539 (14.6)
2	56 (1.1)	7 (0.6)	49 (1.3)
3	5 (0.1)	0 (0.0)	5 (0.1)
Place of biomarker testing procedures, n (%)			
Independent laboratory	275 (37.1)	26 (2.2)	249 (6.7)
Outpatient	266 (36)	33 (2.8)	233 (6.2)
Office/clinic	174 (23.5)	26 (2.2)	148 (4.0)
Inpatient	17 (2.3)	2 (0.2)	15 (0.4)
Emergency room	2 (0.3)	0 (0.0)	2 (0.1)
Other	7 (1.0)	0 (0.0)	7 (0.2)
Erlotinib recipients			
Patients receiving biomarker testing procedures, n	634	80	554
By year, n (%)			
2009	71 (11.2)	34 (2.8)	38 (1.0)
2010	168 (26.5)	27 (2.3)	141 (3.8)
2011	226 (35.6)	12 (1.0)	214 (5.7)
2012	169 (26.7)	6 (0.5)	163 (4.4)
Biomarker testing procedures, n	698	87	611
By year, n (%)			
2009	83 (11.9)	36 (3.0)	46 (1.2)
2010	182 (26.1)	30 (2.5)	152 (4.1)
2011	245 (35.1)	13 (1.1)	232 (6.2)
2012	188 (26.9)	7 (0.6)	181 (4.8)
Mean number of biomarker testing procedures per patient (SD)	0.2 (0.4)	0.1 (0.3)	0.2 (0.4)
Before 2011	0.06 (0.3)	0.06 (0.3)	0.05 (0.3)
After 2011	0.09 (0.3)	0.02 (0.1)	0.11 (0.6)
Total biomarker testing procedures per patient, n (%)			
0	4,167 (84.8)	1,102 (92.9)	3,065 (82.0)
1	574 (12.0)	73 (6.2)	501 (13.4)
2	56 (1.2)	7 (0.6)	49 (1.3)
3	4 (0.1)	0 (0.0)	4 (0.1)
Crizotinib recipients			
Patients receiving biomarker testing procedures, n	41	0	41
Biomarker testing procedure, n	43	0	43
Mean number of biomarker testing procedure per patient (SD)	0.3 (0.5)	0 (0.0)	0.4 (0.5)
Total biomarker testing procedures per patient, n (%)			
0	84 (67.2)	4 (100.0)	80 (66.1)
1	40 (32.0)	0 (0.0)	40 (33.1)
2	0 (0.0)	0 (0.0)	0 (0.0)
3	1 (0.8)	0 (0.0)	1 (0.1)

SD=standard deviation.

TABLE 4 Cost of Biopsy Procedures in Patients with ≥ 1 Biopsy Procedure by Outpatient and Inpatient Setting

	Total Population (N = 3,579)		Previously Diagnosed Patients (n = 800)		Newly Diagnosed Patients (n = 2,779)	
	Outpatient	Inpatient	Outpatient	Inpatient	Outpatient	Inpatient
Total cost per patient, \$						
Copay^a						
All patients, n	3,031	973	709	183	2,322	790
Mean (SD)	60 (147)	180 (691)	50 (151)	216 (742)	63 (146)	172 (679)
Median	4	0	2	0	5	0
Erlotinib recipients, n	2,967	950	707	183	2,260	767
Mean (SD)	60 (147)	179 (693)	50 (151)	216 (742)	63 (146)	170 (681)
Median	4	0	2	0	5	0
Crizotinib recipients, n	64	23	2	0	62	23
Mean (SD)	70 (145)	245 (610)	4 (6)	NA	72 (147)	245 (610)
Median	8	0	4	NA	11	0
Net pay^b						
All patients, n	3,031	973	709	183	2,322	790
Mean (SD)	1,223 (1,899)	8,163 (18,712)	1,127 (1,749)	12,409 (23,523)	1,252 (1,942)	7,180 (17,279)
Median	534	331	491	473	542	322
Erlotinib recipients, n	2,967	950	707	183	2,260	767
Mean (SD)	1,220 (1,896)	8,248 (18,874)	1,130 (1,751)	12,409 (23,523)	1,248 (1,939)	7,256 (17,457)
Median	534	327	492	473	540	314
Crizotinib recipients, n	64	23	2	0	62	23
Mean (SD)	1,340 (2,035)	4,651 (9,540)	36 (50)	NA	1,382 (2,054)	4,651 (9,540)
Median	694	574	36	NA	739	574
Cost per patient by number of biopsy procedures, \$						
1 procedure, n	1,911	861	431	166	1,480	695
Copay						
Mean (SD)	41 (114)	180 (713)	29 (91)	227 (776)	45 (119)	168 (698)
Median	1	0	0	0	2	0
Net pay						
Mean (SD)	778 (1,194)	7,339 (16,879)	693 (1,030)	11,217 (22,199)	803 (1,237)	6,413 (15,213)
Median	342	286	317	428	350	280
2 procedures, n	777	99	181	14	596	85
Copay						
Mean (SD)	84 (181)	167 (457)	79 (215)	116 (205)	86 (169)	175 (487)
Median	13	0	4	5	17	0
Net pay						
Mean (SD)	1,581 (2,070)	12,954 (26,350)	1,309 (1,517)	17,169 (29,068)	1,664 (2,205)	12,260 (25,996)
Median	839	689	696	1,541	873	685
3 procedures, n	250	13	68	3	182	10
Copay						
Mean (SD)	108 (207)	317 (679)	90 (219)	71 (122)	114 (203)	391 (765)
Median	20	0	17	0	24	0
Net pay						
Mean (SD)	2,530 (2,742)	26,246 (41,013)	2,386 (2,854)	56,184 (32,492)	2,584 (2,705)	17,265 (40,246)
Median	1,552	2,038	1,337	59,956	1,675	1,338

Note: Cost and SD are rounded to the nearest whole number.

^aCopay corresponds to the cost in patient perspective.

^bNet pay corresponds to the cost in payer perspective.

NA = not applicable; SD = standard deviation.

an independent laboratory (n=275, 37.1%) or an outpatient hospital (n=266, 36%).

Table 4 describes the cost of biopsy procedures among patients receiving at least 1 biopsy procedure, categorized by

setting (inpatient vs. outpatient) and by perspective (payer vs. patient). Overall mean (SD) biopsy procedure cost was \$1,223 (\$1,899) from the payer and \$60 (\$147) from the patient perspective in the outpatient setting. Incremental increases in per

TABLE 5 Cost of Biomarker Testing in Patients with ≥ 1 Biomarker Testing Procedure

	Total Population (N = 675)	Previously Diagnosed Patients (n = 80)	Newly Diagnosed Patients (n = 595)
Total cost per patient, \$			
Copay^a			
All patients, n	675	80	595
Mean (SD)	43 (229)	34 (147)	44 (238)
Median	0	0	0
Erlotinib recipients, n	634	80	554
Mean (SD)	42 (228)	34 (147)	43 (238)
Median	0	0	0
Crizotinib recipients, n	41	0	41
Mean (SD)	55 (243)	NA	55 (243)
Median	0	NA	0
Net pay^b			
All patients, n	675	80	595
Mean (SD)	891 (1,062)	827 (932)	900 (1,079)
Median	551	395	599
Erlotinib recipients, n	634	80	554
Mean (SD)	906 (1,084)	827 (932)	917 (1,105)
Median	549	395	600
Crizotinib recipients, n	41	0	41
Mean (SD)	664 (576)	NA	664 (576)
Median	563	NA	563
Cost per patient by no. of biomarker testing procedures, \$			
1 procedure, n	614	73	541
Copay			
Mean (SD)	43 (236)	34 (153)	45 (245)
Median	0	0	0
Net pay			
Mean (SD)	819 (932)	845 (946)	816 (931)
Median	513	400	524
2 procedures, n	56	7	49
Copay			
Mean (SD)	38 (159)	27 (60)	40 (169)
Median	0	1	0
Net pay			
Mean (SD)	1,640 (1,854)	635 (807)	1,784 (1,921)
Median	1,317	241	1,384
3 procedures, n	5	0	5
Copay			
Mean (SD)	0	NA	0
Median	0	NA	0
Net pay			
Mean (SD)	1,368 (764)	NA	1,368 (764)
Median	1,608	NA	1,608

Note: Cost and SD are rounded to the nearest whole number.

^aCopay corresponds to the cost in patient perspective.

^bNet pay corresponds to the cost in payer perspective.

NA = not applicable; SD = standard deviation.

patient cost were observed with an increasing number of biopsy procedures. Mean (SD) cost for a biopsy procedure in erlotinib recipients was \$60 (\$147) and \$1,220 (\$1,896) from the patient

and payer perspectives, respectively. In crizotinib recipients, mean (SD) costs were \$70 (\$145) and \$1,340 (\$2,035), respectively. Costs of the biopsy procedures in the outpatient setting were higher in newly diagnosed patients compared with previously diagnosed patients regardless of whether they received erlotinib or crizotinib. In the inpatient setting, mean (SD) biopsy procedure cost was \$8,163 (\$18,712) from the payer and \$179 (\$693) from the patient perspective. Similar to the outpatient setting, per patient costs incrementally increased with the increase in the number of biopsy procedures.

Table 5 shows the costs of biomarker testing in patients who received at least 1 test. Overall per patient mean (SD) cost was \$43 (\$229) and \$891 (\$1,062) from the patient and payer perspectives, respectively. For erlotinib recipients, per patient mean (SD) cost was \$42 (\$228) from the patient and \$906 (\$1,084) from the payer perspective, whereas it was \$55 (\$243) and \$664 (\$576) in crizotinib recipients from patient and payer perspectives, respectively. For patients receiving 1 biomarker test, per patient mean (SD) cost was \$43 (\$236) from patient and \$819 (\$932) payer perspectives. For patients receiving 2 tests, per patient mean (SD) cost was \$38 (\$159) from patient and \$1,640 (\$1,854) payer perspectives.

Discussion

This study analyzed the utilization patterns of and costs associated with biopsy procedures and biomarker testing in patients with metastatic lung cancer receiving erlotinib or crizotinib using a U.S. claims database. A steady increase in the number of erlotinib or crizotinib recipients over the course of the index period was observed. Results in crizotinib recipients should be interpreted with caution because of the small sample size, which was a result of the limited time between crizotinib approval in August 2011 and the end of the index period in September 2012.

Biopsy procedures were identified for only 73.0% of patients. It is possible that an archival tissue sample may have been used in patients without an identifiable biopsy CPT code. Approximately one third of patients (29.1%) received more than 1 biopsy procedure over the course of their disease, especially around the index date. Inadequate tissue sample may have prompted another biopsy procedure in these patients. Some studies have highlighted this issue and reported that only about 50% of tissue samples are adequate for biomarker testing.^{13,29,30} Moreover, a study conducted by Ellis et al. (2013) that investigated challenges in implementing EGFR testing in Canada identified inadequate diagnostic tissue for molecular testing as one of the major challenges.³¹ An international survey conducted among oncologists showed that in addition to inadequate tissue, poor performance status and long turnaround time were the main reasons for not testing.³²

Although guidelines recommend that EGFR and ALK testing be done before starting treatment, we found that only 13.2% of

erlotinib and 32.8% of crizotinib recipients received biomarker testing at any time. In erlotinib recipients, most patients received biomarker testing after 2011 (n=395, 62.3%) but still the mean (SD) number of biomarker testing/patient was low (0.09 [0.3]). *EGFR* assay has been commercially available since 2005, but it became part of the guidelines only in early 2011, which shows delayed uptake of *EGFR* testing.^{33,34} A study examining hospital use of the *EGFR* assay showed that in 2010 only 12% of U.S. acute care hospitals ordered the *EGFR* assay, suggesting most lung cancer patients did not have access to this test.³⁵ We did observe an increase in the number of patients receiving *EGFR* testing from 2009 onward, indicating a steady adoption of the guideline recommendations. Erlotinib recipients without any identifiable biomarker testing claim may have been treated based on clinical characteristics associated with *EGFR* mutation (e.g., nonsmoker, female, and Asian) in the absence of biomarker testing, since guidelines were still evolving during the index period of this study. As anticipated, we found more newly diagnosed patients receiving biomarker testing than previously diagnosed patients (16% vs. 6.7%) as these drugs are approved for first-line treatment. Our results are consistent with another analysis conducted using integrated medical and pharmaceutical data from 4 Blue Cross and Blue Shield plans, where only 36 of 125 (28.8%) erlotinib recipients received a biomarker test in 2011.²⁸ A multidisciplinary approach may be warranted to overcome the challenges in implementing recommended biomarker tests.³⁶

The cost of biopsy and biomarker testing procedures varied by the setting. The mean biopsy procedure cost in the inpatient setting (\$8,163) was consistent with that observed in a retrospective cohort study using the 5% Medicare random national sample data during 2009-2011 (\$8,869 without adverse events).³⁷ Unlike our study, this study did not look at the cost exclusively in patients receiving targeted therapies. The variability in the cost for biomarker testing might be explained by the lack of uniformity in the use of CPT codes while submitting claims for reimbursement during the index period.

Limitations

The results of this study should be considered in the context of several limitations. Because there is no specific ICD-9-CM code for NSCLC, patients with metastatic lung cancer receiving erlotinib or crizotinib were assumed to have non-small cell histology. Since biomarker test results (positive or negative) were not available in the claims database, we were unable to evaluate if the treatment was related to the test outcome. It is also difficult to accurately identify the biomarker testing procedures, since they are not consistently captured in the claims database. Different CPT codes are used for billing purposes of relatively similar biomarker tests. Of note, the CPT code for *EGFR* testing has been available since 2013, although a code for *ALK* testing is still lacking. Considering the scope of the

current database, the link between the timing of the biomarker testing and the corresponding biopsy procedure performed to obtain the tissue sample cannot be established. A biopsy may have been performed for relapses or treatment change or as a part of a diagnostic work-up, but these reasons cannot be assessed from the database. Also, the reimbursed procedures and tests that were not part of this database are not included in the analysis. Because our study was restricted to patients receiving erlotinib or crizotinib, the results of this study cannot be generalized to all patients with metastatic lung cancer because these patients have different clinical presentation. Finally, because the MarketScan database does not capture information on smoking status or histology, we were not able to clearly identify factors associated with *EGFR* testing.

Conclusions

This study provides insight into utilization patterns and the cost of biopsy procedures and biomarker testing in patients with metastatic lung cancer. Despite inclusion in the treatment guidelines, the low frequency of biomarker testing after 2011 suggests a need for increased awareness of the importance of biomarker testing for guiding treatment decisions in these patients. Biopsy procedures and biomarker testing incurred significant costs in patients with metastatic lung cancer receiving targeted therapies, which suggests that they have a tangible economic impact.

Authors

RESHMA SHINDE, MBBS, MPH; XITING CAO, PhD; and SMITA KOTHARI, PhD, MBA, RPh, Center for Observational and Real World Evidence (CORE), Merck & Co., Kenilworth, New Jersey.

AUTHOR CORRESPONDENCE: Reshma Shinde, MBBS, MPH, 600 Corporate Dr., Lebanon, NJ 08833. Tel.: 908.236.5020; E-mail address: reshma.shinde@merck.com.

DISCLOSURES

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Study concept and design were contributed primarily by Shinde and Kothari. Data analysis was performed by Cao. Data interpretation was performed by Shinde, Cao, and Kothari. Shinde wrote the manuscript with assistance from Cao and Kothari. The revision was completed primarily by Shinde and Kothari.

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Biopsy Procedures and Molecular Testing Utilization and Related Costs in Patients with Metastatic Lung Cancer

APPENDIX A Biopsy-Related CPT and ICD-9-CM Codes

Type of Biopsy	CPT (or ICD-9-CM Procedure) Code
Fine needle biopsy	
Fine needle aspiration; without imaging guidance	10021
Fine needle aspiration; with imaging guidance	10022
Closed (percutaneous needle biopsy of lung (FNA of lung or transthoracic needle biopsy of lung)	33.26 (ICD-9-CM)
Percutaneous biopsy	
Biopsy, lung or mediastinum, percutaneous needle	32405
Biopsy, pleura; percutaneous needle	32400
Surgical biopsy	
Thoracotomy, limited, for biopsy of lung or pleura	32905
Thoracotomy, with diagnostic biopsy(ies) of lung infiltrate(s) (e.g., wedge, incisional), unilateral	32096
Thoracotomy, with diagnostic biopsy(ies) of lung nodule(s) or mass(es) (e.g., wedge, incisional), unilateral	32097
Thoracotomy, with biopsy(ies) of pleura	32098
Open biopsy of lung	33.28 (ICD-9-CM)
Bronchial biopsy	
Bronchoscopy, rigid or flexible, including fluoroscopic guidance, when performed; with bronchial or endobronchial biopsy(s), single or multiple sites	31625
Bronchoscopy, rigid or flexible, including fluoroscopic guidance, when performed; with brushing or protected brushings	31623
Bronchoscopy, rigid or flexible, including fluoroscopic guidance, when performed; with bronchial alveolar lavage	31624
Bronchoscopy with transbronchial lung biopsy, single lobe	31628
Bronchoscopy with transbronchial needle aspiration biopsy(s) trachea, main stem and/or lobar bronchus	31629
Bronchoscopy with transbronchial lung biopsy(s), each additional lobe (list separately in addition to code for primary procedure) use with 31628	31632
Bronchoscopy with transbronchial needle aspiration biopsy(s) each additional lobe (list separately in addition to code for primary procedure) use with 31629	31633
Closed endoscopic biopsy of lung (fiber-optic (flexible) bronchoscopy with fluoroscopic guidance with biopsy or transbronchial lung biopsy)	33.27 (ICD-9-CM)
Other	
Thoracoscopic lung biopsy	33.20
Closed [endoscopic] biopsy of bronchus	33.24
Open biopsy of bronchus	33.25
Non-biopsy-specific procedures	
Ultrasound guidance for needle placement	76942
Fluoroscopic guidance for needle placement	77002
CT guidance for needle placement	77012
MR guidance for needle placement	77021

CPT= Current Procedural Terminology; CT= computed tomography; FNA= fine needle aspiration; ICD-9-CM= International Classification of Diseases, Ninth Revision, Clinical Modification; MR= magnetic resonance.

APPENDIX B Biomarker Testing CPT Codes

CPT Code Description	CPT Code
Molecular diagnostics; molecular isolation or extraction, each nucleic acid type (i.e., DNA or RNA)	83890
Isolation or extraction of highly purified nucleic acid, each nucleic acid type (i.e., DNA or RNA)	83891
Enzymatic digestion, each enzyme treatment	83892
Dot/slot blot production, each nucleic acid preparation	83893
Separation by gel electrophoresis (e.g., agarose, polyacrylamide), each nucleic acid preparation	83894
Nucleic acid probe, each 20	83896
Nucleic acid transfer (e.g., Southern, Northern), each nucleic acid preparation	83897
Amplification, target, each nucleic acid sequence	83898
Amplification, target, multiplex, first 2 nucleic acid sequences	83900
Amplification, target, multiplex, each additional nucleic acid sequence beyond 2 (list separately in addition to code for primary procedure)	83901
Reverse transcription	83902
Mutation scanning, by physical properties (e.g., single strand conformational polymorphisms [SSCP], heteroduplex, denaturing gradient gel electrophoresis [DGGE], RNAse A), single segment, each	83903
Mutation identification by sequencing, single segment, each segment	83904
Mutation identification by allele specific transcription, single segment, each segment	83905
Mutation identification by allele specific translation, single segment, each segment	83906
Lysis of cells prior to nucleic acid extraction (e.g., stool specimens, paraffin embedded tissue), each specimen	83907
Amplification, signal, each nucleic acid sequence	83908
Separation and identification by high resolution technique (e.g., capillary electrophoresis), each nucleic acid preparation	83909
Interpretation and report	83912
RNA stabilization	83913
Mutation identification by enzymatic ligation or primer extension, single segment, each segment (e.g., oligonucleotide ligation assay [OLA], single base chain extension [SBCE], or allele-specific primer extension [ASPE])	83914
Array-based evaluation of multiple molecular probes; 11 through 50 probes	88384
51 through 250 probes	88385
251 through 500 probes	88386

CPT = Current Procedural Terminology.

Biopsy Procedures and Molecular Testing Utilization and Related Costs in Patients with Metastatic Lung Cancer

APPENDIX C Molecular Pathology CPT Code Changes Starting January 2013

Latest Update	Test ID	Second ID	Test Name	Current CPT Code	New CPT Code
1/1/2013	20450	20450	FLT3 Mutation Analysis	83892, 83900, 83909	81245
1/1/2013	20451	20451	MPL Exon 10 Mutation Detection, Bone Marrow	83898, 83904x2, 83909x2	81403
1/1/2013	20452	20452	JAK2 Exon 12 Mutation Detection, Bone Marrow	83891, 83898, 83902, 83904x2, 83909x2	81403
1/1/2013	20458	20458	BCR/ABL, p190, Quant, Monitor	83891, 83896x2, 83898x2, 83902	81207
1/1/2013	20459	20459	PML/RARA Quantitative, PCR	83891, 83896, 83898x2, 83902	81315
1/1/2013	20463	20463	KIT Asp816Val Mutation Analysis	83898x2, 83909x2	81402
1/1/2013	20464	20464	BCR/ABL, RNA-Qual, Diagnostic	83891, 83900x2, 83901x10, 83902, 83914x2	81206 81207 81208
1/1/2013	20465	20465	BCR/ABL, p210, Quant, Monitor	83891, 83896x2, 83898x2, 83902	81206
1/1/2013	20471	20471	JAK2 Exon 12 Mutation Detection, B	83891, 83898, 83902, 83904x2, 83909x2	81403
1/1/2013	20472	20472	Nucleophosmin Mutation Analysis	83898, 83909	81401
1/1/2013	20473	20473	BCR/ABL Mutation, ASPE	83891, 83894x2, 83896x8, 83898x2, 83902, 83909, 83914x8	81403
1/1/2013	20474	20474	MPL Exon 10 Mutation Detection, B	83898, 83904x2, 83909x2	81403
1/1/2013	60142	60142	Circulating Tumor Cells, Prostate	0279T, 0280T	86152, 86153
1/1/2013	60694	60694	FOX12 Mutation (C402G) Analysis by PCR and Pyrosequencing	83891, 83892, 83896x2, 83898, 83904, 83907, 83912	81479
1/1/2013	61207	61207	IDH1/IDH2 Genes, Known Mutations	83896x4, 83898x2, 83904x2, 83912	81403, 81403
7/1/2013	83361	83361	Synovial Sarcoma, RT-PCR, Paraffin	81479	81401x2
1/1/2013	83363	83363	Ewings Sarcoma, RT-PCR, Paraffin	83894, 83896x5, 83898x2, 83902, 83912	81401x2
1/1/2013	83365	83365		83894, 83896x2, 83898, 83902, 83912	81401x2
1/1/2013	83367	83367	Alveolar Rhabdomyosarcoma, RT-PCR, PF	83894, 83896x3, 83898x2, 83902, 83912	81401
1/1/2013	88955	88955	KIT, Mutation Analysis, Ex8	83896x2, 83898, 83904, 83912, 83892, 83907, 83891	81404
1/1/2013	88956	88956	KIT, Mutation Analysis, Ex13	83896x2, 83898, 83904, 83912, 83892, 83907, 83891	81404
1/1/2013	88957	88957	KIT, Mutation Analysis, Ex17	83896x2, 83898, 83904, 83912, 83892, 83907, 83891	81404
1/1/2013	88958	88958	PDGFRA, Mutation Analysis, Ex14	83896x2, 83898, 83904, 83912, 83892, 83907, 83891	81404
1/1/2013	89045	89045	BRAF Mutation (T1799A) Analysis	83896x2, 83898, 83904, 83912	81210
1/1/2013	89089	89089	Circulating Tumor Cells, Breast, B	0279T, 0280T	86152, 86153
1/1/2013	89162	89162	Circulating Tumor Cells, Colorectal	0279T, 0280T	86152, 86153
1/1/2013	89669	89669	KIT, Mutation Analysis, Ex9	83896x2, 83898, 83904, 83912, 83892, 83907, 83891	81404
1/1/2013	89670	89670	KIT, Mutation Analysis, Ex11	83896x2, 83898, 83904, 83912, 83892, 83907, 83891	81404
1/1/2013	89671	89671	PDGFRA, Mutation Analysis, Ex12	83896x2, 83898, 83904, 83912, 83892, 83907, 83891	81404
1/1/2013	89672	89672	PDGFRA, Mutation Analysis, Ex18	83896x2, 83898, 83904, 83912, 83892, 83907, 83891	81404
1/1/2013	1A2	89401	CYP1A2 Genotype	83892x2, 83900x2, 83901, 83912, 83914x13	81479
1/1/2013	1A2O	60346	CYP1A2 Genotype, Saliva	83892x2, 83900x2, 83901, 83912, 83914x13	81479
1/1/2013	1STT	87857	First Trimester Maternal Screen	84163, 84702	81508
1/1/2013	2C19O	60335	CYP2C19 Genotype, Saliva	83892, 83894, 83900, 83901x3, 83909x10, 83912	81225
1/1/2013	2C19S	60439	CYP2C19 Sequence Genotype	83892, 83894, 83900, 83901x3, 83909x10, 83912	81225
1/1/2013	2C9S	60528	CYP2C9 Sequence Genotype	83892, 83894, 83900, 83901, 83909x6, 83912	81227
1/1/2013	2C9SO	60337	CYP2C9 Genotype, Saliva	83892, 83894, 83900, 83901, 83909x6, 83912	81227
1/1/2013	2D6	83180	CYP2D6 Genotype	83892, 83900, 83901x2, 83912, 83914x17	81226
1/1/2013	2D6O	60334	CYP2D6 Genotype, Saliva	83892, 83900, 83901x2, 83912, 83914x17	81226
1/1/2013	2D6T	87966	CYP2D6 Genotype - Tamoxifen Therapy	83892, 83900, 83901x2, 83912, 83914x17	81226
1/1/2013	2D6TO	60340	CYP2D6 Tamoxifen Genotype, Saliva	83892, 83900, 83901x2, 83912, 83914x17	81226

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1/1/2013	3A4B	61241	CYP3A4 Genotype, B	83896x2, 83898, 83912	81401
1/1/2013	3A4O	61242	CYP3A4 Genotype, Saliva	83896x2, 83898, 83912	81401
1/1/2013	A1AT	82993	Alpha-1-Antitrypsin Genotyping, Blood	83890, 83896x2, 83898x2, 83912	81332
1/1/2013	A1ATR	83050	A1AT Deficiency Profile	82103, 83890, 83896x2, 83898x2, 83912	81332 82103
1/1/2013	ACVK	89393	ACVRL1 Gene, Known Mutation	83892, 83894, 83898, 83909x2, 83912	81479
1/1/2013	ADHP	83375	FH/ADH Genetic Reflex Panel	83892, 83898, 83912, 83914	81479
1/1/2013	AGPB	9499	Alpha-Globin Gene Analysis	83891, 83894, 83900x2, 83909, 83912, 83914x15	81257
1/1/2013	AGPBT	31032	Alpha-Globin Gene Analysis	83891, 83894, 83900x2, 83909, 83912, 83914x15	81404
1/1/2013	AGXKM	89916	AGXT Gene, Known Mutation	83891, 83912	81479
1/1/2013	AGXMS	89915	AGXT Gene, Full Gene Analysis	83891, 83898x12, 83909x24, 83912	81479
1/1/2013	AGXT	83643	AGXT Mutation Analysis (G170R)	83890, 83892, 83894, 83898, 83912	81479
1/1/2013	AJPWO	88887	Ashkenazi Jewish Mutation Analysis Panel Without Cystic Fibrosis (CF)	83890, 83892, 83896x31, 83900, 83909, 83912, 83914x31	81200, 81330, 81290, 81260, 81255, 81251, 81242, 81209
1/1/2013	AMYKM	83705	Amyloidosis, Transthyretin-Associated Familial, Known Mutation	83890, 83898, 83909x2, 83912	81403
1/1/2013	AMYL	83667	Familial Amyloidosis, DNA Sequence	83890, 83898x4, 83909x8, 83912	81404
1/1/2013	APO1K	60724	APOA1 Gene, Known Mutation	83890, 83898, 83909x2, 83912	81479
1/1/2013	APO1S	60723	APOA1 Gene, Full Gene Analysis	83890, 83898x5, 83909x10, 83912	81479
1/1/2013	APO2K	60726	APOA2 Gene, Known Mutation	83890, 83898, 83909x2, 83912	81479
1/1/2013	APO2S	60725	APOA2 Gene, Full Gene Analysis	83890, 83898x4, 83909x8, 83912	81479
1/24/2013	APOB	89097	APOB Genotype	83892, 83898, 83912, 83914	81401
1/1/2013	APOE	80905	Apolipoprotein E Genotyping, B	83890, 83892, 83894, 83898, 83912	81401
7/1/2013	ARPKD	88911	ARPKD Mutation Screen	81479	81408
7/1/2013	ARPKM	88912	ARPKD Known Mutation	81479	81403
7/1/2013	ARSAK	61260	ARSA Gene, Known Mutation	81479	81403
7/1/2013	ARSAS	61259	ARSA Gene, Full Gene Analysis	81479	81405
1/1/2013	BA190	83336	BCR/ABL, p190, Quant, Monitor	83891, 83896x2, 83898x2, 83902	81207
1/1/2013	BADX	89006	BCR/ABL, RNA-Qual, Diagnostic	83891, 83900x2, 83901x10, 83902, 83914x2	81206, 81207, 81208
1/1/2013	BAKDM	89609	BCR/ABL Mutation, ASPE	83891, 83894x2, 83896x8, 83898x2, 83902, 83909, 83914x8	81403
1/1/2013	BCGBM	31141	Immunoglobulin Gene Rearrange, BM	83912, 83891, 83900, 83901x4, 83909x4	81262 81264
1/1/2013	BCGR	83123	Immunoglobulin Gene Rearrange, B	Varies	81262 81264
1/1/2013	BCGRV	31142	Immunoglobulin Gene Rearrange, V	83912, 83891, 83900, 83901x4, 83909x4	81262 81264
1/1/2013	BCLL	89008	IGH Somatic Hypermutation in B-CLL	83891, 83898x7, 83902, 83904x2, 83909x8	81263
1/1/2013	BCRAB	89007	BCR/ABL, p210, Quant, Monitor	83891, 83896x2, 83898x2, 83902	81206
1/1/2013	BGDD	89575	Beta Globin Gene Del/Dup	83900, 83909, 83914x8	81403
1/1/2013	BGLOB	83287	Beta Globin Gene, Large Del/Dup	83900, 83909, 83914x8	81403
7/1/2013	BIL28	61702	IL28B Polymorphism Genotype, B	81479	81400
1/1/2013	BLM	85316	Bloom Syndrome, Mutation Analysis, 2281del6/ins7	83890, 83892, 83896, 83900, 83909, 83912, 83914	81209
1/1/2013	BRAF	87980	BRAF Mutation Analysis (V600E), Tumor	83898, 83909x2, 83912	81210
1/1/2013	BRAFM	83837	BRAF Mutation Analysis (V600), Melanoma	83890, 83896x2, 83898, 83912, 88387	81210
1/1/2013	BTDKM	89013	BTD Gene, Known Mutation	83890, 83892x2, 83894x2, 83898x2, 83909x4, 83912	81403
1/1/2013	BTDM5	89012	BTD Gene, Full Gene Analysis	83891, 83898x7, 83909x14, 83912	81404
1/1/2013	BTKFP	89742	BTK Full-Gene Panel, B	83892x14, 83894x7, 83898x8, 83900x6, 83909x42, 83912, 83890, 88184	81479, 88184

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7/1/2013	BTKK	89306	BTK Gene, Known Mutation	81479	81403
7/1/2013	BTKKM	29304	BTK Gene, Known Mutation	81479	81403
7/1/2013	BTKS	89307	BTK, Full Gene Sequence	81479	81406
7/1/2013	BTKSP	29305	BTK, Full Gene Sequence	81479	81406
1/1/2013	BWSRS	61010	BWS/RSS Molecular Analysis	83891, 83892, 83900, 83909x2, 83912, 83914x26	81401
7/1/2013	CACTK	61195	SLC25A20 Gene, Known Mutation	81479	81403
7/1/2013	CACTS	61194	SLC25A20 Gene, Full Gene Analysis	81479	81405
1/1/2013	CANW	81780	Canavan Disease, Mutation Analysis, ASPA	83890, 83892, 83896x5, 83900, 83909, 83912, 83914x5	81200
1/1/2013	CDKKM	60229	CDKN1C Gene, Known Mutation	83891, 83898, 83909x2, 83912	81479
1/1/2013	CDKMS	60228	CDKN1C Gene, Full Gene Analysis	83891, 83898x6, 83909x12, 83912	81479
1/1/2013	CELI	88906	Celiac Associated HLA-DQ Typing	86816	81376x2
1/1/2013	CFPB	9497	Cystic Fibrosis Mutation Analysis, 106-Mutation Panel	83788, 83890, 83900x8, 83901x89, 83912, 83914x106	81220
1/1/2013	CFTRK	88880	CFTR Gene, Known Mutation	83891, 83892x2, 83894x2, 83898x2, 83909x4, 83912	81221
1/1/2013	CFTRM	88876	CFTR Gene, Full Gene Analysis	83891, 83898x30, 83909x60, 83912	81223
1/1/2013	CGH	88898	aCGH, Whole Genome, Constitutional	88399	81228
1/1/2013	CHEP	84427	Chimerism-Recipient Engraft	Varies	81267
1/1/2013	CHIDB	83182	Chimerism Donor	Varies	81265
1/1/2013	CHRGB	83186	Chimerism Pre Recip	Varies	81265
1/1/2013	COMT	83301	Catechol Methyltransferase Genotype	83892, 83898, 83912, 83914x2	81479
1/1/2013	COMTO	60336	COMT Genotype, Saliva	83892, 83898, 83912, 83914x2	81479
1/1/2013	CPOXK	61264	CPOX Gene, Known Mutation	83891, 83898, 83909x2, 83912	81479
1/1/2013	CPOXS	61263	CPOX Gene, Full Gene Analysis	83891, 83898x8, 83909x16, 83912	81479
1/1/2013	CPTKM	61121	CPT2 Gene, Known Mutation	83891, 83898x2, 83909x4, 83912	81403
1/1/2013	CPTMS	61120	CPT2 Gene, Full Gene Analysis	83891, 83898x8, 83909x16, 83912	81404
7/1/2013	CSRKM	83704	CASR Known Mutation	81479	81403
7/1/2013	CSRMS	83703	CASR Mutation Screen	81479	81405
1/1/2013	CYPKP	89082	CYP21A2 Known Mutation	83892x2, 83894, 83900, 83901x2, 83909x2, 83912	81403
1/1/2013	CYPSP	89081	CYP21A2 Full Gene Analysis	83892x2, 83894, 83900, 83901x2, 83909x16, 83912	81405
1/1/2013	DISI	89185	HLA Class I Mol Typing DiseaseAssoc	83890, 83894, 83898, 83912	81372
1/1/2013	DISII	32864	HLA ClassII Mol Typing DiseaseAssoc	83890, 83894, 83898, 83912	81375
1/1/2013	DRD3	81776	DRD3 Genotype	83892, 83900, 83912, 83914	81479
1/1/2013	DRD3O	60342	DRD3 Genotype, Saliva	83892, 83900, 83912, 83914	81479
1/1/2013	DRD4	89096	Dopamine Receptor D4 Genotype, B	83894, 83898, 83912	81479
1/1/2013	DRD4O	60344	DRD4 Genotype, Saliva	83894, 83898, 83912	81479
1/1/2013	DRPLA	81801	DRPLA Gene Analysis	83890, 83898, 83909, 83912	81401
7/1/2013	EALDD	31719	ENG and ACVRL1, Large Del/Dup	81479	81405, 81479
1/1/2013	EGFR	61247	EGFR Gene, Mutation Analysis, 29 Mutation Panel, Tumor	83890, 83896x7, 83898x7, 83912	81235
7/1/2013	ENGK	89391	ENG Gene, Known Mutation	81479	81403
7/1/2013	ENGKM	31047	ENG Gene, Known Mutation	81479	81403
1/1/2013	EPOR	61679	EPOR Gene, Mutation Analysis, B	83900, 83904x4, 83909x4	81479
1/1/2013	F5DNA	81419	Factor V Leiden (R506Q) Mutation, B	83891, 83892, 83896x5, 83903, 83908x2, 83912	81241
1/1/2013	FABKM	88266	Fabry Disease Known Mutation	83890, 83892, 83894, 83898, 83909x2, 83912	81403
1/1/2013	FABMS	88264	Fabry Disease Full Gene Analysis	83891, 83898x8, 83909x16, 83912	81405
1/1/2013	FANCA	85318	Fanconi Anemia C Mutation Analysis, IVS4(+4) A->T and 322delG	83890, 83892, 83896x2, 83900, 83909, 83912, 83914x2	81242
1/1/2013	FAPG	91347	ADmark ApoE Genotype Analysis & Interpretation (Symptomatic)	83891, 83892x4, 83896x10, 83908x4, 83912	81401

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1/1/2013	FAPKM	83001	Familial Adenomatous Polyposis (FAP) Known Mutation	83891, 83912	81202
5/1/2013	FAPMS	82582	Familial Adenomatous Polyposis (FAP) Mutation Screen	83891, 83894x4, 83898x21, 83905x4, 83906x4, 83909x34, 83912	81201, 81203
1/1/2013	FBKM	89311	FBN1 Gene, Known Mutation	83892, 83898, 83909x2, 83912	81403
1/1/2013	FBN1	89308	FBN1, Full Gene Sequence	83892x62, 83898x62, 83909x122, 83912	81408
1/1/2013	FBNN	89314	Neonatal Marfan Syndrome, FBN1 Gene	83892x9, 83898x9, 83909x18, 83912	81479
1/1/2013	FBNNP	29301	Neonatal Marfan Syndrome, FBN1 Gene	83892x7, 83898x7, 83912	81479
1/1/2013	FCCEV	57461	Complete CADASIL Evaluation	83891, 83898x23, 83904x23, 83909x23, 83912	81406
1/11/2013	FCMD	91452	Complete Myotonic Dystrophy Evaluation	83891, 83898x2, 83909x2, 83912	81404, 81479
1/1/2013	FD	85319	Familial Dysautonomia, Mutation Analysis, IVS20(+6T->C) and R696P	83890, 83892, 83896x2, 83900, 83909, 83912, 83914x3	81260
1/1/2013	FECHK	60372	FECH Gene, Known Mutation	83891, 83898, 83909x2, 83912	81479
1/1/2013	FECHS	60371	FECH Gene, Full Gene Analysis	83891, 83898x11, 83909x22, 83912	81479
1/1/2013	FFRED	91819	Friedreich Ataxia Repeat Expansion Analysis - Unknown Mutation	83891, 83892x2, 83894x3, 83896, 83897, 83898x2, 83912	81479
1/1/2013	FGAKM	60722	FGA Gene, Known Mutation	83890, 83898, 83909x2, 83912	81479
1/1/2013	FGAMS	60721	FGA Gene, Full Gene Analysis	83890, 83898x10, 83909x20, 83912	81479
1/1/2013	FIXKM	84320	Factor IX Gene Known Mutation	83891, 83892, 83894, 83898, 83912	81403
1/1/2013	FIXMS	84209	Factor IX Gene Mutation Screening	83891, 83892x3, 83894x8, 83900x3, 83901x2, 83912	81405
1/1/2013	FLIMB	91635	Limb Girdle Muscular Dystrophy Evaluation	83891, 83898x133, 83900x3, 83901x62, 83904x133, 83909x136, 83912, 83914x68	81404
1/1/2013	FLT	19739	FLT3 Mutation Analysis	83892, 83900, 83909	81245
1/1/2013	FPMP	91590	PMP22 Duplication/Deletion DNA	83891, 83900, 83901x31, 83909, 83912, 83914x33	81324
1/1/2013	FPRTG	91565	Prometheus TPMT Genetics	83896x6, 83898x3, 83907, 83912	81401
1/1/2013	FXFU	61118	Fragile X, Follow Up Analysis	83892x2, 83893x2, 83894x2, 83896, 83897x2	81244
1/1/2013	FXPB	9569	FragileX Syndrome, Molecular Analysis	83890, 83900, 83909, 83912	81243
1/1/2013	GAAKM	89897	Pompe Disease, Known Mutation	83891, 83898x2, 83909x4, 83912	81403
1/1/2013	GAAMS	89898	Pompe Disease, Full Gene Sequencing	83891, 83898x19, 83909x38, 83912	81406
1/1/2013	GAL3	86202	Galectin-3, S	83520	82777
1/1/2013	GAL6	84366	Galactosemia Gene Analysis	83890, 83896x6, 83898x6, 83912	81401
7/1/2013	GALCK	60695	Krabbe Disease, Known Mutation	81479	81403
7/1/2013	GALCS	60696	Krabbe Disease, Full Gene Analysis	81479	81406
1/1/2013	GALTK	84367	Galactosemia Known Mutation	83890, 83894x2, 83898x2, 83909x4, 83912	81403
1/1/2013	GALTM	88877	GALT Gene, Full Gene Analysis	83891, 83898x9, 83909x18, 83912	81406
1/1/2013	GAUW	81235	Gaucher Disease, Mutation Analysis, GBA	83890, 83892, 83896x8, 83900, 83909, 83912, 83914x8	81251
1/1/2013	GBAKM	60712	Gaucher Disease, Known Mutation	83891, 83892, 83894, 83898, 83909x4, 83912	81403
1/1/2013	GBAMS	60711	Gaucher Disease, Full Gene Analysis	83891, 83892, 83894, 83898, 83909x22, 83912	81479
1/1/2013	GFDKM	89899	FTCD Gene, Known Mutation	83891, 83898x2, 83909x4, 83912	81479
1/1/2013	GFDMS	89900	FTCD Gene, Full Gene Analysis	83891, 83898x14, 83909x28, 83912	81479
7/1/2013	GRNKM	89187	Progranulin Gene, Known Mutation	81479	81403
7/1/2013	GRNMS	89188	Progranulin Gene, Full Gene Analysis	81479	81406
1/1/2013	GSNKM	60718	GSN Gene, Known Mutation	83890, 83898, 83909x2, 83912	81479
1/1/2013	GSNMS	60717	GSN Gene, Full Gene Analysis	83890, 83898x17, 83909x34, 83912	81479
1/1/2013	HAPB	80297	Hemophilia A Mol Anal for Inversion	83891, 83892x2, 83893x2, 83894x2, 83896, 83897x2, 83912	81403
7/1/2013	HCCP	61703	Hereditary Colon Cancer Panel	81201, 81228, 81292, 81295, 81298, 81317, 81319, 81321, 81401, 81405, 81406, 81479	81405, 81406
1/1/2013	HD	61622	Huntington Disease Analysis	83891, 83898x2, 83909, 83912	81401
1/1/2013	HEMP	61337	Hereditary Erythrocytosis Mut, B	83890, 83900x3, 83901x3, 83904x20, 83909x20, 83912	81479

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1/1/2013	HEXKM	89283	HEXA Gene, Known Mutation	83891, 83898x2, 83909x4, 83912	81403
1/1/2013	HEXMS	89278	HEXA Gene, Full Gene Analysis	83891, 83898x14, 83909x28, 83912	81406
1/9/2013	HGBMO	29374	HGB Electrophoresis, Molecular	83891, 83898x4, 83900, 83904x12, 83909x13, 83914x8	81257 81403 81401
1/1/2013	HHEMO	81508	Hemochromatosis HFE Gene Analysis, Blood	83890, 83896x2, 83898x2, 83912	81256
7/1/2013	HHTM	89394	ENG and ACVRL1, Large Del/Dup	81479	81405, 81479
7/1/2013	HHTP	89394	ENG and ACVRL1, Full Gene Analysis	81479	81406, 81405, 81479
7/1/2013	HHTS	31056	ENG and ACVRL1, Full Gene Analysis	81479	81406, 81405, 81479
7/1/2013	HHTSQ	89442	HHT Gene Sequencing	81479	
1/1/2013	HIF2A	61681	HIF2A Gene, Mutation Analysis, B	83900, 83904x4, 83909x4	81479
1/1/2013	HL15O	60348	HLAB 1502 Genotype, Saliva	83894x5, 83900, 83901x8, 83912	81381
1/1/2013	HL57O	60347	HLAB 5701 Abacavir Genotype, Saliva	83894, 83900, 83901, 83912	81381
1/1/2013	HLA15	89347	HLAB 1502 Genotype, Carbamazepine	83894x5, 83900, 83901x8, 83912	81381
1/1/2013	HLA57	89346	HLA-B 5701 Genotype, Abacavir	83894, 83900, 83901, 83912	81381
1/1/2013	HMBSK	61217	HMBS Gene, Known Mutation	83891, 83898, 83909x2, 83912	81479
1/1/2013	HMBSS	61216	HMBS Gene, Full Gene Sequence	83891, 83898x12, 83909x24, 83912	81479
1/1/2013	HNPCC	17073	HNPCC Screen	83890x2, 83900x2, 83901x6, 83909x2, 83912	81301
1/1/2013	HP	83019	Hereditary Pancreatitis, Mutation Screen	83890, 83898x2, 83909x4, 83912	81401
1/1/2013	HPKM	88691	Hered Pancreatitis, Known Mut	83890, 83898, 83909x2, 83912	81403
1/1/2013	HTR2	83303	Serotonin Receptor 2A/2C Genotype	83892, 83900, 83901x3, 83912, 83914x5	81479
1/1/2013	HTR2O	60338	Serotonin Receptor 2A/2C, Saliva	83892, 83900, 83901x3, 83912, 83914x5	81479
1/1/2013	HTT	83302	Serotonin Transporter Genotype	83894, 83898, 83912	81479
1/1/2013	HTTO	60339	Serotonin Transporter (LPR), Saliva	83894, 83898, 83912	81479
7/1/2013	HURLK	61482	Hurler Syndrome, Known Mutation	81479	81403
7/1/2013	HURLS	61481	Hurler Syndrome, Full Gene Analysis	81479	81406
1/1/2013	IVD	83644	IVD Mutation Analysis (A282V)	83890, 83892, 83894, 83898, 83912	81400
1/1/2013	JAK2B	88715	JAK2 V617F Mutation Detection, B	83891, 83896, 83898, 83912	81270
1/1/2013	JAK2M	31155	JAK2 V617F Mutation Detection, BM	83891, 83896, 83898, 83912	81270
1/1/2013	JAK2V	31156	JAK2 V617F Mutation Detection, V	83891, 83896, 83898, 83912	81270
1/1/2013	JAKXB	89189	JAK2 Exon 12 Mutation Detection, B	83891, 83898, 83902, 83904x2, 83909x2	81403
1/1/2013	JAKXM	60025	JAK2 Exon 12 Mutation Detection, BM	83891, 83898, 83902, 83904x2, 83909x2	81403
1/1/2013	KITAS	88802	KIT Asp816Val Mutation Analysis	83898x2, 83909x2	81402
1/1/2013	KRAS	89378	KRAS Gene, 7 Mutation Panel, Tumor	83890, 83896x7, 83898x7, 83912	81275
1/1/2013	KRASQ	89377	KRAS Gene, Exon 2 Gene Seq, Tumor	83890, 83892, 83894, 83898, 83909x2, 83912	81479
7/1/2013	LDLFQ	89124	LDLR Gene Sequencing	81470	81406
7/1/2013	LDLK_	80209	LDLR Gene, Known Mutation	81479	81403
7/1/2013	LDLM	89073	LDLR Large De/Dup RUO	81479	81405
7/1/2013	LDLMP	29285	LDLR Large De/Dup RUO	81479	81405
7/1/2013	LDLRK	81183	LDLR Gene, Known Mutation	81479	81403
7/1/2013	LDLRQ	80098	LDLR, Full Gene Sequence	81479	81406
7/1/2013	LDLRS	81013	LDLR, Full Gene Sequence	81479	81406
7/1/2013	LDLSP	29284	LDLR, Full Gene Sequence	81479	81406
1/1/2013	LUMSC	84353	Luminex Class I/II Ab Scrn, B	86021	86828
1/1/2013	LYZKM	60720	LYZ Gene Known Mutation	83890, 83898, 83909x2, 83912	81479
1/1/2013	LYZMS	60719	LYZ Gene Full Gene Analysis	83890, 83898x4, 83909x8, 83912	81479
7/1/2013	MAHKM	89135	MMACHC Gene, Known Mutation	81479	81403
7/1/2013	MAHMS	89436	MMACHC Gene, Full Gene Analysis	81479	81404
7/1/2013	MAPTK	87925	MAPT Known Mutation	81479	81403
7/1/2013	MAPTM	87924	MAPT Screening Sequence Analysis	81479	81406
1/1/2013	MAS	89573	Alpha Globin Gene Sequence	83898x2, 83904x8, 83909x8	81257
1/1/2013	MBS	89405	Beta Globin Gene Sequence	83898x2, 83904x4, 83909x4	81404

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1/1/2013	MCADK	83934	MCAD, Known Mutation	83891, 83898x2, 83909x4, 83912	81403
1/1/2013	MCADS	60116	MCAD Mutation Screen	83890, 83898x12, 83909x22, 83912	81479
1/1/2013	MCC	88636	Maternal Cell Contamination, Molecular Analysis	83890, 83900x6, 83909x2, 83912	81265
1/1/2013	MCDKM	89831	MLYCD Gene, Known Mutation	83891, 83912	81479
1/1/2013	MCDMS	89830	MLYCD Gene, Full Gene Analysis	83891, 83898x7, 83909x14, 83912	81479
1/1/2013	MCIV	85321	Mucopolidosis IV, Mutation Analysis, IVS3(-2) A->G and del6.4kb	83890, 83892, 83896x2, 83900, 83909, 83912, 83914x2	81290
1/1/2013	ME2KM	89285	MECP2 Gene, Known Mutation	83891, 83912	81303
1/1/2013	ME2MS	89284	MECP2 Gene, Full Gene Analysis	83891, 83898x7, 83909x14, 83912	81302
1/1/2013	MENKM	81082	MEN2 (2A,2B,FMTC) Known Mutation	83891, 83898, 83909x2, 83912	81403
1/1/2013	MENMS	80573	MEN2 (2A,2B,FMTC) Mutation Screen	83891, 83898x6, 83909x12, 83912	81405
1/1/2013	MHDKM	61098	MMADHC Gene, Known Mutation	83891, 83898x2, 83909x4, 83912	81479
1/1/2013	MHDMS	61097	MMADHC Gene, Full Gene Analysis	83891, 83898x8, 83909x16, 83912	81479
1/1/2013	MHRS1	33092	High Resolution Class I Phenotype	83894, 83898, 83912	81379
1/1/2013	MHRS2	33093	High Resolution Class II Phenotype	83894, 83898, 83912	81382x2
1/1/2013	MLBRF	87931	MLH1 Hypermethylation/BRAF Mutation	83898x3, 83907, 83909x3, 83912	81210 81479
1/1/2013	MLH12	83191	MLH1/MSH2 Mutation Screen	83891, 83898x37, 83909x74, 83912	81292, 81295, 81294, 81297
1/1/2013	MLH1H	87978	MLH1 Hypermethylation (also part of a profile test 87931 with BRAF)	83898x2, 83907, 83909, 83912	81479
1/1/2013	MLHKM	83002	MLH1 Known Mutation	83891, 83912	81293
1/1/2013	MLHMS	83015	MLH1 Mutation Screen	83891, 83898x19, 83909x38, 83912	81292, 81294
1/1/2013	MMLDD	83192	hMLH1/hMSH2 Large Deletion/Duplication	83900, 83909, 83914x37	81294, 81297
1/1/2013	MPCR	80226	DNA Analysis B	83891, 83894x2, 83898x2, 83912	81479
1/1/2013	MPLB	89776	MPL Exon 10 Mutation Detection, B	83898, 83904x2, 83909x2	81403
1/1/2013	MPLM	60024	MPL Exon 10 Mutation Detection, BM	83898, 83904x2, 83909x2	81403
1/1/2013	MSH2K	83082	MSH2 Known Mutation	83891, 83912	81296
1/1/2013	MSH2M	83016	MSH2 Mutation Screen	83891, 83898x18, 83909x36, 83912	81295, 81297
1/1/2013	MSH6K	83706	MSH6 Known Mutation	83891, 83912	81299
1/1/2013	MSH6L	88893	hMSH6 Large Deletion/Duplication	83900, 83909, 83914x10	81300
1/1/2013	MSH6M	83723	MSH6 Mutation Screen, Blood	83891, 83898x19, 83909x38, 83912	81298, 81300
1/1/2013	MSHDB	89849	MSH6 Large Deletion/Duplication, MLPA	83900, 83909, 83914x10	81300
1/1/2013	MSIO	88566	Microsatellite Instability (MSI), Tumor	83890x2, 83900x2, 83901x6, 83909x2, 83912	81301
1/1/2013	MTHFR	81648	Methylenetetrahydrofol Reduc Mut, B	83891, 83892, 83896x5, 83903, 83908x2, 83912	81291
1/1/2013	MYH	84304	MYH Gene Analysis	83891, 83892x2, 83894x2, 83898x2, 83912	81401
1/1/2013	NAGR	82943	Hexosaminidase A and Tot, WBC/Mole	83080x2	83080x2
3/25/2013	NARC	82026	Narcolepsy Associated Ag, B	83890, 83894, 83898, 83912, 86816	81376
1/1/2013	NAT2	83389	NAT2, Full Gene Sequence	83892, 83894, 83898, 83909x8, 83912	81479
1/1/2013	NAT2F	29262	NAT2, Full Gene Sequence	83892, 83894, 83898, 83912	81479
1/1/2013	NAT2O	60345	NAT2 Full Gene Sequence, Saliva	83892, 83894, 83898, 83909x8, 83912	81479
7/1/2013	NPCKM	83118	Niemann-Pick Type C, Known Mutation	81479	81403
7/1/2013	NPCMS	89015	NPC Mutation Screen	81479	81404, 81406
1/1/2013	NPD	85322	Niemann-Pick Disease, Types A and B, Mutation Analysis	83890, 83892, 83896x4, 83900, 83909, 83912, 83914x4	81330
1/1/2013	NPDKM	61116	Niemann-Pick A-B, Known Mutation	83891, 83898x2, 83909x4, 83912	81403
1/1/2013	NPDMS	61117	Niemann-Pick A-B Full Gene Analysis	83891, 83898x11, 83909x22, 83912	81479
1/1/2013	NPM1	89292	Nucleophosmin Mutation Analysis	83898, 83909	81401
1/1/2013	NT2FO	32808	NAT2, Full Gene Sequence	83892, 83894, 83898, 83912	81479
7/1/2013	OIL28	61701	IL28B Polymorphism Genotype, Saliva	81479	81400
1/1/2013	OPRM1	89612	OPRM1 Genotype, Naltrexone Efficacy	83896x2, 83898, 83912	81479
1/1/2013	OPRMO	60352	OPRM1 Genotype, Naltrexone, Saliva	83896x2, 83898, 83912	81479
1/1/2013	PHD2	61683	PHD2 Gene, Mutation Analysis, B	83900, 83901x3, 83904x12, 83909x12	81479

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1/1/2013	PMLR	84114	PML/RARA Quantitative, PCR	83891, 83896, 83898x2, 83902	81315
1/1/2013	PMS2K	61174	PMS2 Gene, Known Mutation	83891, 83912	81318
1/1/2013	PMS2S	61173	PMS2 Gene, Full Gene Analysis	83891, 83894x3, 83898x7, 83900, 83909x33, 83912, 83914x34	81317
1/1/2013	PROD	60552	Influenza Virus A/B and RSV, PCR	87502, 87798	87631
1/1/2013	PT11	89463	PTPN11, Full Gene Sequence, B	83892x15, 83894, 83898x15, 83909x28, 83912	81406
1/1/2013	PT11S	33870	PTPN11, Full Gene Sequence	83892x15, 83894, 83898x15, 83912	81406
1/1/2013	PT1K	89464	PTPN11 Gene, Known Mutation, B	83892, 83894, 83898, 83909x2, 83912	81403
1/1/2013	PT1KS	33874	PTPN11 Gene, Known Mutation	83892, 83894, 83898, 83912	81403
1/1/2013	PTNT	81742	Prothrombin G20210A Mutation, B	83891, 83892, 83896x5, 83903, 83908x2, 83912	81240
1/1/2013	PTP22	89315	PTPN22 Genotype, I858C>T	83896x2, 83898, 83912	81479
1/1/2013	PWDNA	81153	Prader-Willi/Angelman Syndrome, Molecular Analysis	83891, 83892x2, 83900, 83909x2, 83912, 83914x25	81331
1/1/2013	QUAD	81149	Quad Screen (Second Trimester) Maternal, Serum	82105, 82677, 84702, 86336	81511
1/1/2013	SABC1	89667	Class I Antibody Single Ag Bead	86021	86832
1/1/2013	SABC2	89668	Class II Antibody Single Ag Bead	86021	86833
1/1/2013	SBMA	81176	Spinobulbar Musc Atrophy, Kennedy's	83890, 83898, 83909, 83912	81401
1/1/2013	SCADK	83947	SCAD Known Mutation	83891, 83898x2, 83909x4, 83912	81403
1/1/2013	SCADM	83939	SCAD Mutation Screen	83891, 83898x9, 83909x18, 83912	81405
1/1/2013	SDHDD	89555	SDH Deletion Detection	83900, 83901x21, 83909, 83912, 83914	81403
1/1/2013	SDHKM	89554	SDH Known Mutation	83892, 83894, 83900, 83909x2, 83912	81403
1/1/2013	SDHSB	89551	SDH Subunit B Gene Analysis	83892x3, 83894x3, 83898, 83900x2, 83901x3, 83909x16, 83912	81405
1/1/2013	SDHSC	89552	SDH Subunit C Gene Analysis	83892x3, 83894x3, 83898, 83900x2, 83901, 83909x12, 83912	81405
1/1/2013	SDHSD	89553	SDH Subunit D Gene Analysis	83892x2, 83894x2, 83900x2, 83909x8, 83912	81404
1/1/2013	SDHSP	89550	SDH Gene Analysis	83892x8, 83894x8, 83898x2, 83900x6, 83901x4, 83909x36, 83912	81404, 81405
1/1/2013	SEPTK	61101	SEPT9 Gene, Known Mutation	83891, 83912	81479
1/1/2013	SEPTS	61100	SEPT9 Gene, Mutation Screen	83891, 83898x3, 83900, 83909x7, 83912, 83914x16	81479
1/1/2013	SEQF	60700	Sequential Maternal Screening, Part 2, Serum	82105, 82677, 84702, 86336	81599
1/1/2013	SHDD	31846	Succinate Dehydrogenase (SDH) Deletion Detection	83900, 83901x21, 83909, 83912, 83914	81403
7/1/2013	SLC1B	61736	SLCO1B1 Genotype, Statin B	81479	81400
7/1/2013	SLC1O	61737	SLCO1B1 Genotype, Statin, Saliva	81479	81400
1/1/2013	SPCID	82971	Specimen Source Identification	83890, 83900x6, 83909x2, 83912	81265
1/1/2013	TACIF	84388	TACI, Full Gene Sequence	83894x5, 83898x5, 83909x12, 83912	81479
1/1/2013	TACIG	89122	TACI Gene, Known Mutation	83892, 83894, 83898, 83909x2, 83912	81479
1/1/2013	TACIM	28588	TACI Gene, Known Mutation	83892, 83894, 83898, 83912	81479
1/1/2013	TACIS	28582	TACI, Full Gene Sequence	83894x5, 83898x5, 83912	81479
1/1/2013	TCGBM	31139	T Cell Receptor Gene Rearrange, BM	83912, 83891, 83900, 83901x4, 83909x6	81340, 81342
1/1/2013	TCGR	83122	T Cell Receptor Gene Rearrange, B	Varies	81340, 81342
1/1/2013	TCGRV	31140	T Cell Receptor Gene Rearrange, V	83912, 83891, 83900, 83901x4, 83909x6	81340, 81342
1/1/2013	TG1F	32501	TGFBR1 Full Gene Sequence	83891, 83892x11, 83894, 83898x11, 83912	81405
1/1/2013	TG1K	32504	TGFBR1 Gene, Known Mutation	83891, 83892, 83894, 83898, 83912	81403
1/1/2013	TG2F	31751	TGFBR2 Full Gene Sequence	83892x12, 83894, 83898x12, 83912	81405
1/1/2013	TG2K	31754	TGFBR2 Gene, Known Mutation	83892, 83894, 83898, 83912	81403
1/1/2013	TGF1	89459	TGFBR1, Full Gene Sequence	83891, 83892x11, 83894, 83898x11, 83909x18, 83912	81405
1/1/2013	TGF2	89461	TGFBR2 Full Gene Sequence	83892x12, 83894, 83898x12, 83909x22, 83912	81405
1/1/2013	TGFK1	89460	TGFBR1 Gene, Known Mutation	83891, 83892, 83894, 83898, 83909x2, 83912	81403

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1/1/2013	TGFK2	89462	TGFB2 Gene, Known Mutation	83892, 83894, 83898, 83909x2, 83912	81403
2/12/2013	TREC	87959	Thymopoiesis Assessment Profile	83896x4, 83898x2, 83907, 83912	81479
1/1/2013	TSD	82588	Tay-Sachs Disease, Mutation Analysis, HEXA	83890, 83892, 83896x7, 83900, 83909, 83912, 83914x7	81255
1/1/2013	TUMSI	82500	Microsatellite Instability (MSI), Tumor	83890x2, 83900x2, 83901x6, 83909x2, 83912	81301
1/1/2013	U1A1	83949	UGT1A1 TA Repeat Genotype	83898, 83909, 83912	81350
1/1/2013	U1A1O	60343	UGT1A1 TA Repeat Genotype, Saliva	83898, 83909, 83912	81350
1/1/2013	UBEKM	89920	UBE3A Gene, Known Mutation	83891, 83898, 83909x2, 83912	81403
1/1/2013	UBEMS	89919	UBE3A Gene, Full Gene Analysis	83891, 83898x12, 83909x24, 83912	81406
1/1/2013	UGKMO	32811	UGT1A1 Gene, Known Mutation	83892, 83894, 83898, 83912	81403
1/1/2013	UGT1	29338	UGT1A1 Gene Sequence, Irinotecan	83892, 83894, 83900, 83901x3, 83912	81350
1/1/2013	UGT1O	32809	UGT1A1 Gene Sequence, Irinotecan	83892, 83894, 83900, 83901x3, 83912	81350
1/1/2013	UGT2	89611	UGT1A1 Sequence, Hyperbilirubinemia	83892, 83894, 83900, 83901x3, 83909x19, 83912	81350
1/1/2013	UGT2O	60350	UGT1A1 Sequence, Hyperbili, Saliva	83892, 83894, 83900, 83901x3, 83909x19, 83912	81350
1/1/2013	UGTH	30984	UGT1A1 Sequence, Hyperbilirubinemia	83892, 83894, 83900, 83901x3, 83912	81350
1/1/2013	UGTHO	32810	UGT1A1 Sequence, Hyperbilirubinemia	83892, 83894, 83900, 83901x3, 83912	81350
1/1/2013	UGTI	89397	UGT1A1 Gene Sequence, Irinotecan	83892, 83894, 83900, 83901x3, 83909x19, 83912	81350
1/1/2013	UGTIO	60349	UGT1A1 Sequence, Irinotecan, Saliva	83892, 83894, 83900, 83901x3, 83909x19, 83912	81350
1/1/2013	UGTK	89396	UGT1A1 Gene, Known Mutation	83892, 83894, 83898, 83909x2, 83912	81403
1/1/2013	UGTKM	30987	UGT1A1 Gene, Known Mutation	83892, 83894, 83898, 83912	81403
1/1/2013	UGTKO	60351	UGT1A1 Gene, Known Mutation, Saliva	83892, 83894, 83898, 83909x2, 83912	81403
1/1/2013	UPD	82970	Uniparental Disomy	83891, 83900x3, 83909, 83912	81402
1/1/2013	VHDD	31762	VHL Deletion Detection	83900, 83901x14, 83909, 83914	81403
1/1/2013	VHLD	89211	VHL Deletion Detection	83900, 83901x14, 83909, 83912, 83914	81403
1/1/2013	VHLKP	89084	VHL Known Mutation	83892, 83894, 83900, 83909x2, 83912	81403
1/1/2013	VHLSP	89083	VHL Full Gene Analysis	83892x2, 83894, 83900, 83901x4, 83909x6, 83912	81404
1/1/2013	VLCKM	60037	VLCAD Deficiency, Known Mutation	83891, 83898, 83909x2, 83912	81403
1/1/2013	VLCMS	60036	VLCAD Deficiency, Full Gene Analysis	83891, 83898x13, 83909x26, 83912	81406
1/1/2013	VWD2N	81662	von Willebrand Disease 2N (Normandy)	83890, 83892x3, 83894x3, 83898x3, 83912	81401
1/1/2013	WARFO	60341	Warfarin Sensitive Genotype, Saliva	83892, 83894, 83900, 83901x2, 83909x8, 83912	81227, 81355
1/1/2013	WARFP	60529	Warfarin Sensitivity Genotype	83892, 83894, 83900, 83901x2, 83909x8, 83912	81227, 81355
1/1/2013	WARFQ	87844	Warfarin Sensitivity Genotyping	83909x8	81223
1/1/2013	WARFS	89033	Warfarin Sensitivity, Genotype	83892, 83894, 83900, 83901x2, 83912	81227, 81355
1/1/2013	WARSO	32807	Warfarin Sensitivity Genotype, Saliva	83892, 83894, 83900, 83901x2, 83912	81227, 81355
1/1/2013	WDKM	83698	Wilson Disease Known Mutation	83891, 83898x2, 83909x4, 83912	81403
1/1/2013	WDMS	83697	Wilson Disease Mutation Screen	83891, 83898x22, 83909x44, 83912	81406
1/1/2013	YMICR	82992	Y Microdeletion	83890, 83894x2, 83900, 83912	81403
1/1/2013	ZYG	81252	Zygosity Testing (Multiple Births)	83891, 83900x6, 83909x2, 83912	81265

CPT = Current Procedural Terminology.