Challenges of Estimating Health Service Utilization for Osteoarthritis Patients on a Population Level

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ABSTRACT. ***Objective.*** To examine how estimates of osteoarthritis (OA) related health service utilization and medical care charges vary based on how the population of patients is defined, we compared a large cohort of patients identified through an administrative OA diagnosis relative to a subgroup of patients in whom this diagnosis had been validated through medical record review.

Methods. We identified all members (≥ 18 years of age) of a Massachusetts group model health maintenance organization (HMO) with documentation of at least one health care encounter associated with an OA diagnosis during the period 1994–96 (n = 10,740). From this population we randomly selected 700 subjects. Trained nurse reviewers abstracted relevant clinical, laboratory, and radiologic data from their medical records. Physician reviewers evaluated the abstracted information and rated the evidence for the presence of OA according to 3 levels (definite, possible, and unlikely). All persons rated by the physician reviewers as having definite OA were included in the validated subgroup (n = 442). Health service utilization and medical care charges were assessed in all persons with an administrative OA diagnosis who were not randomly sampled (n = 10,040) and the validated subgroup (n = 442) across the following domains: (1) ambulatory encounters associated with an OA diagnosis, (2) relevant radiographic studies, (3) relevant surgical procedures, and (4) relevant medication use.

Results. Those in the validated subgroup had higher rates of ambulatory OA associated health care encounters, radiographic studies, surgical procedures, and analgesic and/or antiinflammatory medication dispensings. Patients in the validated subgroup were significantly more likely to be in the highest quartile for total one year charges for the care of OA.

Conclusion. Estimates of health service utilization are substantially higher for populations of patients in whom a diagnosis of OA has been validated through medical record review, as compared with unvalidated populations identified solely through diagnoses contained in administrative records. Thus using health service utilization estimates based on an unvalidated sample may lead to an inaccurate estimate when extrapolated to the overall population of patients with OA. (J Rheumatol 2002;29:1931–6)

Key Indexing Terms:
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In 1990, an estimated 15% of the United States population (37.9 million) reported having some form of arthritis. By 2020, the prevalence of arthritis is projected to rise to 18.3% of the population[1]. The costs associated with the treatment of arthritis are substantial; in 1992, the total direct and indirect costs were US $64.8 billion[2]. For this reason, there has been considerable interest in evaluating the health service utilization associated with the care of chronic arthritic conditions[3-6]. Some researchers have assessed health service utilization in osteoarthritis (OA) using claims data based on an administrative diagnosis of OA, while others have studied patients with validated diagnoses based on medical record review[3-9]. It is unclear how estimates of health service utilization obtained from the 2 sources compare.

Administrative databases provide the potential to identify large patient populations with specified diagnoses based on healthcare claims[10]. However, there are concerns about such approaches. In a prior study, we observed that the positive predictive value of an OA diagnosis in the administrative database of a health maintenance organization (HMO) was 62%[11]. Similarly, Gabriel and coworkers, using a community-wide database in Minnesota, found that only 60% of individuals with a database diagnosis of OA fulfilled criteria

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for OA following a medical record review[12]. Conversely, patients with a validated diagnosis of OA through medical record review may represent a subset of the population with more severe disease since they sought medical evaluation and treatment; these individuals may not represent the full spectrum of persons with this condition. We compared a large cohort of patients identified through an administrative OA diagnosis to a subgroup of patients in whom this diagnosis had been validated through medical record review in order to examine how estimates of OA related health service utilization and medical care charges vary based on how the population of patients is defined.

MATERIALS AND METHODS

Study population. Fallon Community Health Plan is a mixed model HMO located in Central and Eastern Massachusetts. The study population included only members of the group model component of the plan. The computerized information system of the health plan contains records on utilization of all health care services, including medical diagnoses for both inpatient and outpatient encounters, as well as enrollment, demographic, and prescription drug data. These data are collected as part of routine fiscal activities. A total of 123,901 individuals 18 years of age or older were enrolled in the health plan during the period 1994 through 1996.

We identified all enrollees 18 years of age or older, with documentation of at least one health care encounter associated with an OA diagnosis (International Classification of Diseases, ICD-9 codes 715.00–715.99) during the period 1994 through 1996, and who continued to be enrolled in the health plan for a one year period following the first identified OA associated health care encounter (n = 10,740). From this group we randomly selected 700 individuals, whose medical records were obtained for review. The procedure for validating OA diagnoses has been described[11]. Briefly, the medical records were abstracted by trained nurse reviewers utilizing a structured data collection instrument to ascertain information relating to the American College of Rheumatology criteria for the classification and reporting of OA of the hand, hip, and knee[13-15]. The medical records of each study subject were abstracted for any pertinent clinical information (history, physical examination, laboratory and radiologic information) on musculoskeletal conditions during the period 2 years prior to the date of the health care encounter with an administrative OA diagnosis, and 12 months following that date. Four clinicians (3 rheumatologists, LRH, RAY, JIR, and one internist-geriatrician, JHG), who were blinded to the presence or absence of an administrative OA diagnosis, reviewed the clinical information contained in the abstractions. The clinical information on each patient was reviewed by 2 of the physician reviewers, who independently evaluated the strength of evidence supporting the presence of a clinical diagnosis of OA at any body site (e.g., spine, shoulder, elbow, hand, hip, knee, and foot) by implicit review based on all available abstracted information. Each physician reviewer characterized the diagnosis of OA based on the available information as "definite," "possible," or "unlikely." Disagreements between physician reviewers in terms of OA rating were resolved by consensus following the independent reviews.

Utilization data. OA related health service utilization was assessed in all persons with an OA diagnosis in the administrative database who were not randomly sampled (n = 10,040) and among those in the validated subgroup during the 12 month period following the date of the first identified health care encounter with an administrative OA diagnosis[11]. Utilization data were assessed across the following domains: (1) ambulatory encounters associated with an OA diagnosis; (2) relevant radiographic studies (e.g., spine, shoulder, hand, hip, knee, and foot radiographs); (3) relevant surgical procedures (e.g., arthroscopic procedures of the knee or hip, or hip/knee replacements); and (4) relevant medication dispensings [e.g., nonsteroidal antiinflammatory drugs (NSAID), nonacetylated salicylates, opioid analgesics, and intraarticular steroids].

Health service utilization involving ambulatory encounters was determined by identifying current procedural terminology (CPT) codes for outpatient encounters associated with diagnoses that could reflect OA care based on ICD-9 codes (Appendix). Radiographic studies were identified using CPT codes for musculoskeletal radiographs, computed tomography of an upper extremity or a lower extremity joint, and magnetic resonance imaging of an upper extremity joint or a lower extremity joint (Appendix). Surgical procedures for OA were identified using CPT codes (Appendix). Medication use was measured by determining dispensings of selected prescription medications including: NSAID, nonacetylated salicylates, and opioid analgesics. To ascertain use of injected corticosteroids, CPT codes for joint injections were used (Appendix). Use of durable medical equipment was identified using HMO-specific codes for such equipment (including walkers, canes, wheelchairs, crutches, etc.) (Appendix).

Estimating charges. We used charges for medical care services reflecting the 75th percentile of charge levels for similar services in the local geographic area at the time that the service was provided. Average wholesale prices were used to assign prices for dispensed medications.

Statistical analyses. Health service utilization (ambulatory encounters, radiographic studies, surgical procedures, and medications) was determined during a one year period of observation for the administrative OA diagnosis group (n = 10,040) and the validated subgroup (n = 442). Chi-square tests were used to evaluate differences in the proportions of each study group receiving a particular health care service. The charges associated with each type of health care service were compared between the 2 populations (the administrative OA diagnosis group and the validated subgroup) using t tests. The distribution of total charges for health care services was assessed and quartiles were determined for both study groups. Differences in the proportions of patients in the highest quartile for charges were compared between the administrative OA diagnosis group and the validated subgroup using chi-square statistics.

RESULTS

The administrative OA diagnosis group and the validated subgroup were similar in terms of age and sex (Table 1). Across all health care service domains, intensity of care was higher among the validated subgroup. The validated subgroup had a higher rate of ambulatory OA associated

Table 1. Age and sex characteristics of the administrative osteoporosis (OA) diagnosis group and the validated subgroup of patients with OA.

	Administrative Diagnosis Group		Validated Subgroup	
	N = 10,040	%	N = 442	%
Female				
< 50	696	7	19	4
50–59	881	9	42	9
60–69	1603	16	65	15
70–79	2103	21	112	25
80+	972	10	48	11
Total	6255	62	286	65
Male				
< 50	636	6	26	6
50–59	607	6	19	4
60–69	990	10	40	9
70–79	1137	11	55	12
80+	415	4	16	4
Total	3785	38	156	35

health care encounters (376 vs 327 encounters per 100 person-years), radiographic studies (133 vs 107 studies per 100 person-years), surgical procedures (3 vs 2 procedures per 100 person-years), and analgesic and/or antiinflammatory medication dispensings (458 vs 344 dispensings per 100 person-years) (Table 2).

A higher percentage of the validated subgroup was evaluated by a rheumatologist or orthopedic surgeon (31% vs 23%, p = 0.001, and 25% vs 20%, p = 0.01, respectively). A higher percentage of the validated subgroup had relevant radiographic studies as compared to those in the administrative OA diagnosis group (58% vs 47%, p = 0.001). Specifically, members of the validated subgroup more commonly had radiographs of the hip, knee, and spine. There were no significant differences in the proportion of each population having surgical procedures during the study period. A greater percentage of the validated subgroup were dispensed relevant medications compared to the administrative OA diagnosis group (71% vs 64%, p = 0.01). Members of the validated subgroup more commonly had intraarticular steroid injections.

As described in Table 3, the charges associated with all ambulatory encounters were 23% higher in the validated subgroup compared with the administrative OA diagnosis group (US $291.94 vs $236.63 per person-year, p = 0.037). The charges associated with dispensings of analgesic and antiinflammatory medications were 43% higher in the validated subgroup compared to the administrative OA group ($150.78 vs $105.60 per person-year, p = 0.01). There was a 20% charge difference for radiographic studies between the 2 populations ($100.58 per person-year in the validated subgroup vs $83.79 per person-year in the administrative diagnosis group, p = 0.056). There was no significant difference between the 2 groups in regard to charges for surgical procedures or durable medical equipment. Patients in the validated subgroup were significantly more likely to be in the highest quartile of total charges for OA including ambulatory encounters, radiographic studies, surgical procedures,

Table 2. Health care utilization among the administrative OA diagnosis group and the validated subgroup of patients with OA.

	Administrative Diagnosis Group, n = 10,040		Validated Subgroup, n = 442	
	% of Population	No. per 100 Person-yr	% of Population	No. per 100 Person-yr
Ambulatory encounters[8]				
Primary care (IM/FP)	76	134.6	77	147.74
Rheumatology	23	41.82	31	66.97
Orthopedics	20	43.47	25	55.20
Ambulatory urgent care	4	5.29	5	7.01
Hospital emergency room	1	0.62	1	1.13
Chiropractor	2	10.03	2	9.95
Physical Therapy	20	91.36	20	87.56
Total	94	327	97	376
Radiologic studies				
Hand x-ray	7	8.74	10	13.80
Hip x-ray	12	19.01	16	23.30
Knee x-ray	22	30.86	27	37.78
Spine x-ray	15	20.57	21	29.86
Shoulder x-ray	6	7.80	7	7.69
Feet x-rays	11	18.02	12	18.78
CT scan and MRI of joints	2	2.25	2	1.58
Total	47	107	58	133
Surgical procedures				
Hip replacement	0.6	0.58	0.7	0.68
Knee replacement	1.0	1.09	1.0	1.36
Other procedure	0.4	0.39	0.9	1.13
Total	2	2	3	3
Medication dispensing				
NSAID	43	180.76	47	215.38
NAS***	12	42.17	16	62.22
Opioid analgesics	28	101.18	30	145.48
Injected steroids	13	20.34	20	35.29
Total	64	344	71	458

* Encounters were associated with an OA diagnosis. NSAID: nonsteroidal antiinflammatory medications. NAS: nonacetylated salicylates. MRI: magnetic resonance imaging. CT: computerized tomography. IM: internal medicine, FP: family practice.

Table 3. Charge information among the administrative OA diagnosis group and the validated subgroup of patients with OA.

Type of Care	Administrative Diagnosis Group, n = 10,040 $ per Person-yr (± SD)	Validated Subgroup, n = 442 $ per, Person-yr (± SD)
Ambulatory encounter*		
Primary care (IM/FP)	80.69	83.94
Rheumatology	29.56	41.40
Orthopedics	24.22	30.12
Ambulatory urgent care	2.26	3.42
Hospital emergency room	2.80	10.16
Chiropractor	8.59	5.62
Physical Therapy	88.51	117.28
Total	236.63 (547.11)	291.94 (532.67)
Radiologic studies		
Hand x-ray	6.10	7.50
Hip x-ray	11.96	13.69
Knee x-ray	19.16	23.58
Spine x-ray	24.10	31.93
Shoulder x-ray	6.10	6.10
Feet x-ray	9.23	12.09
CT scan and MRI of joints	7.14	5.69
Total	83.79 (181.61)	100.58 (170.63)
Surgical procedures		
Hip replacement	99.18	187.01
Knee replacement	210.76	193.70
Other procedures	4.31	6.80
Total	314.25 (2602.94)	387.52 (2946.14)
Medications		
NSAID	33.47	42.20
NAS	40.89	51.63
Opioid analgesics	10.13	23.74
Injected steroids	21.11	33.21
Total	105.60 (885.51)	150.78 (325.45)
Durable medical equipment	9.45 (196.34)	6.88 (108.66)
Total	749.72	937.69

* Encounters were associated with an OA diagnosis. NSAID: Nonsteroidal antiinflammatory medications. NAS: nonacetylated salicylates. SD: Standard deviation. IM: internal medicine, FP: family practice.

medication dispensings, and durable medical equipment compared with patients in the administrative OA diagnosis group (relative risk 1.23, 95% confidence interval 1.07–1.42).

DISCUSSION

Across all health care domains, rates of health service utilization were higher among the validated subgroup compared to those with an administrative OA diagnosis. This increased utilization by the validated subgroup was associated with higher total charges for OA care compared to the administrative OA diagnosis group.

Administrative databases are increasingly being used for health services research. They provide an opportunity for health care researchers to capture the complete health service utilization experience, including outpatient and inpatient care, dispensed medications, procedures utilized, and charges for care, of large populations in readily retrievable databases. It has been suggested that in the managed care setting, health service utilization databases that contain information on outpatient appointments, pharmaceutical agents, and diagnostic testing tend to be highly accurate since they support clinical activities[16]. However, diagnostic information contained in these databases may be inaccurate[17]. Studies have demonstrated the positive predictive value of an OA diagnosis to be about 60% in both administrative and clinical databases[11,12]. Therefore, use of such databases to estimate health care utilization may be misleading.

Using data from the National Health and Nutrition Examination Survey I and the 1990 United States population estimates, Lawrence and coworkers calculated that about 20.7 million adults have OA[18]. Based on findings of our study, charges for this population, using numbers derived from the administrative OA diagnosis group, would be $15.5 billion. However, if estimates were based on the

validated subgroup, total charges for OA care would be $19.4 billion (25% more). Differences of this magnitude could have a substantial impact on decision-making by health care systems around resource allocation at the local, regional, and national level.

It is assumed that estimates of health service utilization based on a population of patients in whom a diagnosis has been validated may be more accurate. In our study, physician reviewers evaluated the strength of evidence supporting an OA diagnosis based on abstracted health care provider notes, laboratory test results, and reports on radiographic studies. Patients with multiple visits for the condition, receipt of a radiographic study, or an evaluation by a rheumatologist or orthopedic surgeon were more likely to be included in the validated subgroup, simply because documentation needed to validate the OA diagnosis was more likely to be present in the medical record. In addition, patients who are evaluated by specialists, such as rheumatologists and orthopedic surgeons, may be more likely to have radiologic studies performed, leading to an iatrogenic increase in health service utilization for the patients with a validated diagnosis. Patients with mild OA symptoms may not have sought treatment, or if they had, the symptoms and physical findings may not have resulted in adequate documentation in the medical record, and radiologic studies may not have been performed, reducing the likelihood of validating the diagnosis[19]. Therefore, the validated subgroup in our study may not adequately reflect the general population of OA patients.

In summary, estimates of health service utilization are substantially higher for populations of patients in whom a diagnosis of OA has been validated through medical record review, as compared with unvalidated populations of patients identified solely through diagnoses contained in administrative records. The extrapolation of estimates of health service utilization from validated samples may lead to an overestimate when applied to the overall population of patients with OA, just as estimates derived from unvalidated populations could lead to an underestimate, through the inclusion of patients who do not actually have the diagnosis. Our findings suggest a dilemma for health care systems, insurers, pharmaceutical manufacturers, disease management companies, and policymakers as these entities seek to determine health care utilization and costs for the growing population of patients with OA.

APPENDIX

CPT codes for outpatient encounters
- 99201-99205, 99211-99215, 99241-99245

CPT codes for emergency room encounters
- 99281-99288, 90500-90580

ICD-9 codes that could reflect osteoarthritis care
- 715.00-715.99 osteoarthritis
- 716.90-716.99 arthritis
- 719.00-719.09 joint effusion
- 719.40-719.49 joint pain/arthralgia
- 724.5 back pain
- 729.5 pain in limb

CPT codes for radiologic studies
- 72010-72080, 72100-72133, 72220 x-ray of spine
- 73020-73030, 73050 shoulder x-ray
- 73120-73140 hand x-ray
- 73500-73502 hip x-ray
- 73560-73565 knee x-ray
- 73600-73610, 73620-73660 foot x-ray
- 73200-73202 computed tomography of upper extremity joint
- 73700-73702 computed tomography of lower extremity joint
- 73221 magnetic resonance imaging of upper extremity joint
- 73721 magnetic resonance of lower extremity joint

CPT codes for surgical procedures
- 27445-27447 knee replacement
- 27125, 27130, 27132 hip replacement
- 27090-27091 removal of hip prosthesis
- 27488 removal of knee prosthesis
- 27134-27138 revision of total hip arthroplasty
- 27486-27487 revision of total knee arthroplasty
- 27448, 27450, 27454 osteotomy of the femur
- 27457 osteotomy of the proximal tibia
- 26841-26842 arthrodesis of the first carpometacarpal joint
- 29861-29863 arthroscopy hip, surgical with removal of loose body or foreign body; with debridement/shaving of articular cartilage, abrasion arthroplasty and/or resection of labrum; with synovectomy
- 29874-29879 arthroscopy, knee, for removal of loose body or foreign body; synovectomy, limited; synovectomy, major; debridement/shaving of articular cartilage; abrasion arthroplasty

CPT code for joint injections 20600-20610

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