A Patient-Based Analysis of Drug Disorder Diagnoses in the Medicare Population

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This article utilizes the Part A Medicare provider analysis and review (MEDPAR) file for fiscal year (FY) 1987. The discharge records were organized into a patient-based record that included alcohol, drug, and mental (ADM) disorder diagnoses as well as measures of resource use. The authors find that there are substantially higher costs of health care incurred by the drug disorder diagnosed population. Those of the Medicare population diagnosed with drug disorders had longer lengths of stay (LOSs), higher hospital charges, and more discharges. Costs increased monotonically as the number of drug diagnoses increased. Overlap of mental and alcohol problems is presented for the drug disorder diagnosed population.

INTRODUCTION

Nationwide interest in the cost to society of drug abuse has been on the rise in recent years, particularly among those groups responsible for national, State, and local policy, as well as among leaders of industry confronted by soaring health insurance costs and diminished worker productivity. A recent estimate of the overall cost is $58 billion dollars (Rice et al., 1990). Methods used to estimate these costs have varied considerably, and have been consistently hampered by the meager availability of data on both the distribution and dynamics of drug disorders in society and the ways and means to most effectively treat those afflicted. Prevention efforts are also hampered by the lack of data delineating the associated costs, risk factors, and determinants of individual susceptibility. The investment in drug treatment has increased, as has a recognition of the need for additional data on the effects of drug disorders on hospital costs.

Current research relies on selected samples of the population, such as those referred for treatment by the criminal justice system, or national representative samples, such as those used in the National Hospital Discharge Survey (NHDS). Such samples are limited in their generalizability to the rest of the national population or even to smaller demographic groups of interest. In the case of a national sample, the researchers face small cell sizes when attempting disaggregation.[1] Furthermore, in a discharge survey such as NHDS, there is no way for researchers to identify and combine records to access information on patient history, because the sampling is done on discharges. It would be impossible to link all records to do a patient-based analysis because the sampling scheme will elimi-

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[1]Rice and Kelman (1989) averaged 3 years of NHDS discharge data in order to obtain reliable estimates on ADM disorder comorbidity. A typical year had approximately 200,000 discharges.

nate some of these records. Thus, the great advantage of using 1 fiscal year of administrative records, such as the discharge records of the Medicare Hospital Part A billing record, is the ability to assemble discharges into one patient record. Patient-based studies to date have been limited in scope both because of the difficulties in obtaining a patient's complete medical administrative records and the great expense of following patients in prospective studies.

Opportunities to examine the Medicare population are available within the large reimbursement system data base. These data comprise about 96 percent of the population 65 years of age or over. The data on the Medicare disabled population represent a much smaller proportion of the total disabled population because of the stringent process to obtain eligibility. Although Medicare data include actual yearly charges for essentially the entire Medicare population, the reported charges are very limited in scope (in this case, to short-stay, inpatient, hospital facilities) and do not represent the total spectrum of incurred expenses in the aged population. The availability of data for the disabled Medicare population provides an opportunity to study a younger population. They make up 9.2 percent of the total Medicare population. Little is known about the ADM disorder comorbidity of this group.

A recent study (Cartwright and Ingster, to be published) conducted on Medicare discharge data indicated that the expectation of higher charges associated with hospital stays involving drug disorders is not necessarily borne out. Evidence from this study showed that, on a per discharge basis, drug disorder diagnosed patients incur lower charges than patients not diagnosed with drug disorders. This finding motivated us to change the unit of analysis from discharge to the patient. We speculated that these patients may initially be healthier in order to support the underlying drug abuse or dependency that leads to the drug disorder, may be discharged earlier, or may simply require less of the acute, intensive, and costly care normally associated with short-stay hospital visits, and incur the lower costs associated with constant observation or convalescent care. Economic factors associated with the Medicare reimbursement system itself, particularly the prospective payment system (PPS), may also influence or require hospitals and physicians to discharge drug disorder diagnosed patients sooner than they might otherwise. Another possible reason for the observed lower charges may lie with the diagnosis-related group (DRG) codes. Prior to FY 1988, certain types of comorbidities were not reimbursable, which may have resulted in an underestimate of the "true" prevalence of patients with drug disorders by their *International Classification of Diseases, 9th Revision, Clinical Modification* (ICD-9-CM) discharge codes.

In this article, annual charges for patients are aggregated from a year of discharge data so that comparisons may be made between patients with diagnoses of drug disorder and patients with no drug disorder. We hypothesize that patients with drug disorder diagnoses might be more frequent users of inpatient hospital resources. In practice therefore, the patients with identified ICD-9-CM drug disorder diagnoses would cost more on an annual basis than would patients without this disorder. This hypothesis would then be reflected in longer average LOSs, higher average annual hospital charges,

and a greater number of average annual discharges. The population results in this article provide evidence that this is the case.

METHODS

The entire universe of Medicare discharges submitted for reimbursement during FY 1987 was utilized to create a patient file. These data were collected by the Health Care Financing Administration (HCFA) and can be found in the Part A MEDPAR[2] file. The discharge records were sorted and matched by beneficiary identification code, provider number, and Social Security number codes, which would identify all records belonging to one individual. The analysis file is limited to individuals who were inpatients in short-stay hospitals.[3] Medicare patients classified with end stage renal disease (ESRD) were excluded because of the uncertain interpretation of drug disorder effects for a terminal renal disease, and those discharges whose principal diagnosis would fall into the ICD-9-CM category of "pregnancy, childbirth, and puerperium" were also excluded because of the unique nature of this medical event.

The variables selected for examination were race, gender, age, Medicare status (aged, disabled), LOS (days), total hospital charges, and the five discharge diagnoses per record. These were used to create several broad drug disorder diagnostic groups and to identify tobacco use

disorder, and alcohol and psychiatric disorders. Statistics presented by race were limited to white and black persons and do not cover the remaining population. The other race categories did not have sufficient numbers to allow for meaningful population comparisons across the desired categories. The Medicare status category of "aged" is comprised of individuals 65 years of age or over, and the "disabled" category is comprised of those individuals either physically or mentally disabled, who are under 65 years of age and qualify for Medicare support. Summary files were created that provide information on a variety of cross-categories demographically.

Demographic summary statistics were created for patients identified by the presence or absence of any drug-disorder diagnosis (either principal or comorbid) during any hospitalization occurring in FY 1987 and, correspondingly, for alcohol and psychiatric disorders. The drug disorder diagnoses were systematically developed from the discharge record. Alcohol and mental disorders were identified by ICD-9-CM codes in major diagnostic categories (MDCs) 19 and 20 from the *Diagnosis-Related Groups, Fourth Revision—Definitions Manual.* Table 1 indicates the ICD-9-CM codes used to define the drug disorders and subsequently specify six categories. Within these categories, ICD-9-CM Code 305 is non-specific and could be possibly either alcohol or drug. Therefore, it was not included in the non-dependent drug abuse category. Principal and comorbid diagnoses were taken from the five discharge diagnoses available on the discharge record, denoting the first diagnosis as principal and the remaining four as comorbid. Six drug disorder diagnostic categories were created: adverse reac-

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[2]The data are subject to stringent requirements under the privacy act. The administrative records are processed in the NIDA Medicare Analysis System that is designed to facilitate drug abuse research. (For details, see Cartwright et al., to be published.)

[3]Approximately 50,000 patients who entered the Medicare system through service with the Nation's railroads were excluded. The time and costs involved to implement a complex recording scheme for this group were not reasonable for processing more than 10 million records.

tions; psychoses; dependence; tobacco; non-dependent drug abuse; and poisoning.

In order to estimate the effects of a drug diagnosis on resource utilization at the patient level, several annual estimates were created. These were average annual LOS (the sum of days in the hospital during FY 1987 for all patients in the same category divided by the number of patients), average annual hospital charges (the sum of all hospital charges during FY 1987 divided by the number of patients in the same category), and the average number of discharges per patient during FY 1987 per category.

The summary statistics were then disaggregated to see if any of the drug disorder diagnostic categories were associated with longer LOSs, higher hospital charges, or higher rates of hospital discharges per year. Patients with multiple drug disorder diagnoses were also stratified by the number of different drug diagnoses they had, and summary statistics were separately calculated.

The interpretation of comorbidity in a patient-based analysis varies from the in-

Table 1

ICD-9-CM Codes Used to Define Principal and Comorbid Drug Abuse

Diagnostic Categories	ICD-9-CM Code	Classification
Adverse Reactions[1]	E935.0	Heroin
	E935.1	Methadone
	E935.2	Other opiates and related narcotics
	E937	Sedatives and hypnotics
	E938	Other central nervous system depressants and anesthetics
	E939	Psychotropic agents
	E940	Central nervous system stimulants
Psychoses	292	Drug psychoses
Dependence	304	Drug dependence
([2])	305	Non-dependent abuse of drugs
Tobacco	305.1	Tobacco use disorder
Non-Dependent Drug Abuse	305.2	Cannabis abuse
	305.3	Hallucinogen abuse
	305.4	Barbiturate and similarly acting sedative or hypnotic abuse
	305.5	Opioid abuse
	305.6	Cocaine abuse
	305.7	Amphetamine or related acting sympathomimetic abuse
	305.8	Antidepressant type abuse
	305.9	Other, mixed, or unspecified drug abuse
Poisoning	357.6	Polyneuropathy due to drugs
	760.72	Narcotics affecting fetus or newborn via placenta or breast milk
	760.73	Hallucinogenic agents affecting fetus or newborn via placenta or breast milk
	779.5	Drug withdrawal syndrome in newborn
	965.0	Poisonings by opiates and related narcotics
	967	Poisonings by sedatives and hypnotics
	969	Poisoning by psychotropic agents

[1]This category refers to drugs causing adverse effects in therapeutic use.
[2]Used for drug totals, but not in specific categories, because unable to ascertain whether alcohol or drug. Loss = 2 clients.

NOTES: ICD-9-CM is International Classification of Diseases, 9th Revision, Clinical Modification. Diagnostic categories have been defined by the authors and do not necessarily follow the clinical divisions of the ICD-9-CM.

SOURCE: Public Health Service and Health Care Financing Administration: ICD-9-CM, 1980.

Table 2

Number of Medicare Patients From Short-Stay Hospitals and Average Annual Number of Discharges, by Selected Characteristics: Fiscal Year 1987

Characteristic	Number of Patients	Average Number of Discharges
Total	6,163,471	1.57
Race		
White	5,515,835	1.56
Black	520,034	1.64
Gender		
Male	2,743,379	1.60
Female	3,420,092	1.54
Medicare Status		
Aged	5,582,760	1.55
Disabled	580,711	1.76

SOURCE: Authors' calculations from the Part A Medicare provider analysis and review file, fiscal year 1987.

terpretation of comorbidity in a discharge record analysis. In a patient-based data analysis, an individual who has both a primary diagnosis of alcohol abuse in one hospital discharge and a primary diagnosis of drug dependence in a second hospital discharge in the same year would be considered comorbid or overlapping, even though the diagnoses were not co-occurring. In a discharge data analysis, the individual would not count as comorbid because this record did not indicate a co-occurring condition.

RESULTS

Approximately 6 million Medicare beneficiaries were hospitalized in FY 1987 and included in this study (Table 2). The distribution of these patients by race, gender, and Medicare status can be seen in Tables 2 and 3. The average annual discharge rate is slightly higher for the disabled population than for the aged population. The discharge rate for the black population is higher than that for the white population. A higher percent of the black Medicare population is disabled (18.6 percent) compared with the white population (8.4 percent). There are more females than males among the aged population, and there are more males among the disabled population.

Table 4 presents the percent of the patient base stratified by the presence of any diagnoses identified as ADM disorders during FY 1987. Patients with any combination of two or more diagnoses were classified as having ADM disorders. As expected, the largest percent of any race, gender, or Medicare status group was attributed to the mental disorder category. The disabled Medicare population was substantially more afflicted by these disorders than was the aged Medicare population. Alcohol disorder diagnoses were more prevalent among the black Medicare population compared with the white population, and a similar observation was made for males versus females. Focusing on the drug disorder diagnosed population, a higher prevalence of disabled persons versus aged persons were identified with the disorder. There appears to be an increased rate of white persons with drug diagnoses over black persons, and there is higher prevalence among males than among females.

Table 3

Number of Aged and Disabled Medicare Patients, by Race and Gender: Fiscal Year 1987

Medicare Status	White	Black	Other[1]	Male	Female
Aged	5,049,980	423,306	109,474	2,393,116	3,189,644
Disabled	465,855	96,728	18,128	350,263	230,448

[1]Other includes all other races and race unknown.

SOURCE: Authors' calculations from the Part A Medicare provider analysis and review file, fiscal year 1987.

Table 4

Percent of Aged and Disabled Medicare Clients with Alcohol, Drug, and Mental (ADM)[1] Disorders from Hospital Discharges, by Race and Gender: Fiscal Year 1987

Race and Gender	ADM	Alcohol	Drug	Mental
		Percent		
Total	0.86	1.14	0.68	10.07
Aged				
Race:				
White	0.52	0.84	0.61	9.28
Black	0.48	1.73	0.37	9.68
Gender:				
Male	0.56	1.59	0.61	7.19
Female	0.49	0.41	0.58	10.81
Disabled				
Race:				
White	4.03	2.88	1.58	18.03
Black	4.32	5.52	1.41	14.84
Gender:				
Male	4.88	4.97	1.65	15.79
Female	2.97	0.92	1.40	20.18

[1]ADM refers to clients with two or more of these disorders.

SOURCE: Authors' calculations from the Part A Medicare provider analysis and review file, fiscal year 1987.

Table 5

Number and Percent of Aged and Disabled Medicare Patients, by Drug Diagnosis and Presence or Absence of Alcohol or Mental Disorders: Fiscal Year 1987

Presence or Absence of Alcohol or Mental Disorders	Drug Diagnosis		No Drug Diagnosis	
	Number	Percent	Number	Percent
Aged				
Total	51,567	100.00	5,531,193	100.00
No Alcohol or Mental Disorder	32,971	63.94	4,951,325	89.52
Alcohol	2,253	4.37	51,015	0.92
Mental Disorder	15,269	29.61	518,548	9.37
Alcohol and Mental Disorders	1,074	2.08	10,305	0.19
Disabled				
Total	24,886	100.00	555,825	100.00
No Alcohol or Mental Disorder	9,023	36.26	426,428	76.72
Alcohol	2,777	11.16	19,518	3.51
Mental Disorder	9,318	37.44	101,810	18.32
Alcohol and Mental Disorders	3,768	15.14	8,069	1.45

SOURCE: Authors' calculations from the Part A Medicare provider analysis and review file, fiscal year 1987.

Table 5 shows the distribution of the aged and disabled Medicare population by the presence or absence of drug or alcohol or mental disorders (principal or comorbid) on any discharge during FY 1987. The percent of the Medicare aged population with these disorders reported is displayed alongside the percent of the Medicare disabled population with the same disorders reported. The prevalence rate for drug disorder diagnoses is four times higher for the disabled population than for the aged. The highest concentration of the drug diagnosed is split between patients with mental disorders only, and patients without either mental or alcohol disorders.

Among the aged and disabled drug diagnosed patients, 30 and 37 percent, respectively, were also diagnosed with a

Table 6

Average Annual Number of Discharges, Length of Stay, and Hospital Charges, by Drug Diagnoses, Alcohol or Mental Disorders, and Medicare Status: Fiscal Year 1987

	Aged			Disabled		
Item	Number of Discharges	Length of Stay	Hospital Charges	Number of Discharges	Length of Stay	Hospital Charges
Total						
Drug	2.23	19.4	$12,663	2.64	24.0	$13.617
No Drug	1.54	13.7	10,145	1.72	15.3	11,307
No Alcohol or Mental Disorder						
Drug	2.04	16.3	11,955	2.30	17.8	13,259
No Drug	1.50	13.0	9,969	1.66	13.8	11,431
Alcohol						
Drug	2.15	18.6	11,535	2.32	20.3	10,860
No Drug	1.67	16.4	11,162	1.88	16.0	10,600
Mental						
Drug	2.61	25.7	14,175	2.73	27.4	14,290
No Drug	1.93	19.8	11,659	1.87	20.8	10,891
Alcohol and Mental Disorder						
Drug	3.11	30.4	15,262	3.46	33.3	14,844
No Drug	2.27	24.8	13,609	2.46	24.5	11,678

SOURCE: Authors' calculations from the Part A Medicare provider analysis and review file, fiscal year 1987.

mental disorder. Among the aged and disabled with no drug diagnosis, 9 and 18 percent, respectively, were diagnosed with a mental disorder. Among the aged and disabled drug diagnosed, 4 and 11 percent, respectively, had an alcohol diagnosis, as compared with 1 and 4 percent, respectively, in the non-drug diagnosis group. Among the disabled drug diagnosed patients, 15 percent had both an alcohol and a mental disorder.

There are substantially higher costs of health care incurred by the drug disorder diagnosed population, as seen in Table 6. Regardless of the type of cost measurement shown, whether number of discharges per year, LOSs, or hospital charges, the Medicare population diagnosed with drug disorders consistently averages higher values. When the patient's health was also compromised by mental disorders, the cost of inpatient care rose markedly. The breakdown of the Medicare population by aged and disabled definitions shows a slight increase in these measurements for the disabled. The same information was generated for comparisons between gender and race: the patterns are very similar (data not shown). Thus, patients diagnosed with drug disorders were heavier users of inpatient hospital resources during a 1-year period than were patients without these disorders. When disaggregated by gender, there are no exceptions among the variables of hospital charges or annual number of discharges. There is less of a pattern witnessed in LOS. In comparing white and black beneficiaries, there is a rise in hospital charges and LOS for patients with drug disorders, but no discernible pattern for annual number of discharges.

Stratifying by race and gender (Table 7), patients with drug diagnoses have longer annual LOSs and higher annual hospital charges than do patients without drug diagnoses. These effects occur irrespective of race and gender considerations. The one observation that appears contrary to the overall pattern is the marginal increase in hospital charges for aged black males with alcohol or mental disorders. This difference is rather small, and LOS does move in the direction observed for the other data. The same increase in charges and LOS for patients with alcohol or mental disorders is also maintained. As previously demonstrated, it is the addition of these complications (and not Medicare status) that plays the key role in inflating the statistics.

Table 8 presents patterns existing among the different types of drug disorder diagnoses, under the premise that one or more particular categories of drug disorders may be responsible for most of the observed increase in cost attributed to patients with these diagnoses. Table 8 has been stratified by the Medicare aged and disabled populations into those patients diagnosed with only one type of drug disorder. Data are also presented for those patients with multiple categories of drug disorders. Although initially the different combinations of categories were analyzed, there seemed to be no patterns for the various combinations that could not simply be ascribed to how many categories of drug disorders a patient was diagnosed as having.

Both drug psychoses and drug dependence are associated with the highest resource utilization for the aged and the disabled Medicare populations. Tobacco use disorder differs only slightly for patients without drug disorder diagnoses. Poison-ings appeared to be more severe for the aged Medicare population in terms of hospital discharges and LOS. The disabled Medicare population display greater effects when presented with drug abuse or adverse drug reactions. All patients with diagnoses of drug disorders are nonetheless associated with longer LOSs and higher hospital charges than patients without diagnoses of drug disorders.

For patients with multiple drug disorders, LOS and hospital charges increase with the number of diagnoses. Analyses were conducted with multiple drug disorder diagnoses, excluding tobacco use disorder, but little difference was found in comparison with the data presented. There were no patients with a history of five different drug disorders. Patients with four reported drug disorders, however, did have the largest cost and LOS, and they were also the smallest group.

When the data were stratified by race and gender (not presented), there were few observable differences. Among the black population, a diagnosis of adverse drug reactions appeared to be as costly as diagnoses of drug psychoses or drug dependence. The white population showed a substantially smaller effect from adverse drug reactions. Annual averages for males versus females displayed similar patterns to those already reported.

DISCUSSION

This patient-based analysis differs in significant ways from an analysis of discharge data. In a discharge data analysis, the investigator is presented with a record structured to indicate a first diagnosis that is considered primary and possible second to fifth diagnoses that are

Table 7

Average Annual Length of Stay and Charges for Medicare Inpatients in Short-Stay Hospitals, by Medicare Status, and Presence of Alcohol or Mental Disorders, and Drug Diagnosis: Fiscal Year 1987

Medicare Status and Alcohol or Mental Disorder Presence	Drug Diagnosis	White Males		White Females		Black Males		Black Females	
		Length of Stay	Hospital Charges	Length of Stay	Hospital Charges	Length of Stay	Hospital Charges	Length of Stay	Hospital Charges
Aged									
Combined	Drug	19.0	$13,532	19.7	$11,951	19.1	$13,361	21.3	$14,053
	No Drug	13.2	10,598	13.6	9,470	16.6	12,615	16.7	12,008
No Alcohol or	Drug	16.3	12,874	16.2	11,142	16.8	12,653	17.4	12,828
Mental Disorder	No Drug	12.6	10,408	12.9	9,311	15.8	12,309	15.8	11,746
Alcohol	Drug	24.7	14,943	25.3	13,200	23.9	14,815	28.7	16,299
or Mental Disorder	No Drug	19.9	12,537	19.0	10,689	22.5	14,904	22.9	13,984
Disabled									
Combined	Drug	22.8	12,928	25.3	14,103	24.9	14,723	25.4	15,007
	No Drug	14.6	11,128	15.7	10,809	16.9	12,924	16.7	12,433
No Alcohol or	Drug	16.2	12,451	18.5	13,266	21.7	15,972	21.1	14,918
Mental Disorder	No Drug	13.2	11,312	13.8	10,742	15.9	13,401	15.4	12,485
Alcohol	Drug	26.6	13,201	29.4	14,610	26.5	14,121	28.3	15,066
or Mental Disorder	No Drug	19.3	10,514	21.7	11,029	19.7	11,600	22.1	12,198

SOURCE: Authors' calculations from the Part A Medicare provider analysis and review file, fiscal year 1987.

Table 8

Average Annual Lengths of Stay, Hospital Charges, and Number of Discharges for Medicare Clients, by Type and Quantity of Drug Diagnoses: Fiscal Year 1987

Type and Quantity of Drug Diagnoses	Aged			Disabled		
	Length of Stay	Hospital Charges	Number of Discharges	Length of Stay	Hospital Charges	Number of Discharges
None	13.7	$10,145	1.5	15.3	$11,307	1.7
Type						
Abuse	19.6	11,310	2.2	25.3	12,337	2.4
Poisonings	21.1	13,550	2.4	20.7	11,849	2.5
Psychoses	22.2	14,390	2.3	26.1	17,164	2.7
Dependence	25.7	15,157	2.5	26.5	14,811	2.6
Adverse Reactions	19.0	11,673	2.2	24.4	13,390	2.4
Tobacco Use Disorder	14.0	11,053	2.0	16.2	11,574	2.3
Quantity						
1	22.3	12,893	2.5	31.2	16,408	3.5
2	33.5	16,169	3.3	41.4	22,373	4.9
3	49.9	23,317	6.5	45.9	21,968	6.2
4	0.0	0	0.0	73.7	47,032	10.0

SOURCE: Authors' calculations from the Part A Medicare provider analysis and review file, fiscal year 1987.

considered secondary or comorbid. When assembling discharge data into an annual patient record, the structure of this information (primary and secondary) loses much of its meaning. Drug diagnosed patients are identified using both the principal and secondary diagnoses of the relevant discharges for the entire year. Within the drug diagnoses, distinctions are made according to the diagnostic criteria previously discussed.

Although the elderly are not generally targeted as a population suffering from a substantial amount of drug disorders, the growing size of this population and the demonstrated additional burden that drug disorders place on Medicare resource consumption warrant further investigation into the distribution and dynamics of drug disorders in this population. According to Rice and Kelman (1989), 22 percent of average annual short-stay hospital costs attributed to ADM disorders were ascribed to persons 65 years of age or over. Of the $1.453 billion expended for psychotropic prescription drugs, $265 million went to the Medicare population

65 years of age or over. These figures indicate the potential for future growth in drug disorders among the elderly. For the disabled, drug abuse disorders occur more frequently, reflecting the younger age of this group.

From the Medicare data, we demonstrate an increase among measures of cost on an annual basis for patients identified with any drug disorder diagnoses. Average LOS per year for the Medicare aged without any drug disorders was 13 days. This figure increased to 16.3 days for the aged with drug disorders and peaked at 30.4 days for patients with ADM disorders. Similar patterns were observed for the disabled, even though they are a much more uniquely selected population. The difference in average hospital discharges per year for a patient with ADM disorders amounts to a $5,293 increase over an aged patient with no drug disorders. A similar increase of $3,413 can be seen for the disabled. Considering the expected growth of the elderly population base, these costs are quantitatively important.

This pattern of increasing burden holds regardless of the many cross-tabulations that were examined among race and gender. Although previous examination (Cartwright and Ingster, to be published) of the data by discharge indicated reduced LOS and hospital charges, when annual estimates were made, the results altered dramatically and unequivocally in this patient-based examination of the same data. Patients with drug disorders were more frequent users of short-stay hospital resources, even though they averaged shorter stays. Examination of the impact of DRGs on hospital admissions by Rosenheck et al. (1990) and McGuire et al. (1987) led to the authors' independent conclusions that the DRG-based PPS would "systematically redistribute revenues to facilities with shorter lengths of stay." This phenomenon, and the increases in readmission rates found in studies of DRG impact on Department of Veterans Affairs Hospitals, lend support to the pattern of discharge versus annual costs that is found for both the disabled and aged Medicare populations in this study.

The distribution of average annual discharges, hospital charges, and LOS for the six different drug disorder categories has physiologic support in the known progression of the severity of drug disorders. The various cost proxies increase with greater severity of drug disorders. Drug dependence (the stage following drug abuse) and drug psychoses are the most severe manifestations of the six categories and, correspondingly, exhibit the highest number of hospital visits, inpatient days per year, and annual hospital charges. Tobacco use disorder, however, a relatively mild form of drug disorder, is nearly indistinguishable in cost from the category of no drug disorders. Similarly, patients with multiple drug disorders diagnosed throughout the year can be assumed to be sicker than those with only single disorders diagnosed. It comes as no surprise that increased severity of ill health would be manifest in demonstrated higher costs and utilization of services.

This examination of patient drug-related costs and LOS varies considerably from epidemiologic studies of similar comorbidity phenomena. For example, aged Medicare population estimates vary substantially for race and age from comparable U.S. Bureau of the Census population counts (Fisher et al., 1990), although both sources of data are comparable for total elderly population counts. Second, these data are restricted to hospital inpatient short stays that are recovered in the administrative records and are obtained from the process of diagnostic coding. An alternative approach to case finding is represented in the work of Regier et al. (1990), which utilized a survey instrument to determine prevalence rates and associated resource demands attributable to ADM comorbidity. Both methods are subject to unique patterns of bias. For drug abuse coding, there are no companion studies that verify the accuracy of the coding process, such as Iezzoni (1988) did for the coding of myocardial infarction. Such research would be vital to an understanding of the clinical and policy ramifications of resource use generated by drug comorbidity.

This article provides additional information on overlap of alcohol and mental disorders for drug diagnosed patients which may complement two previous studies (Rice and Kelman, 1989; Regier et al., 1990). Care must be taken in comparing

results of the many differences in both study populations and comorbidity concepts. The disabled Medicare population had higher rates of ADM overlap than the aged Medicare population. Given the nature of the disability population, the rates of overlap seem to be lower than what might be expected.

There are various definitions of comorbidity used in analysis of ADM. A lifetime prevalence approach (Regier et al., 1990) begins with an identification of the one or more ADM conditions for which the individual has ever met a diagnostic criterion. A statistical association between the disorders indicates either causation or some underlying third factor which may jointly cause the disorders (e.g., physiological or psychological vulnerability). Such an approach would be difficult to further refine so that temporal order may be established and causation determined. On the other hand, discharge data of ADM comorbidity essentially compress the temporal aspect towards a short interval in time, the medical episode. These data are more directly related to what a clinician would actually see and diagnose. Comorbidity rates from discharge data would be smaller than the rates from a lifetime prevalence approach. For example, prevalence rates tend to monotonically increase from 1 month to 6 months to lifetime periods and, similarly, so would comorbidity rates. The comorbidity rates found in this article are consistent with this discussion.

CONCLUSION

This article shows the value of examining data in a longitudinal framework where multiple discharges may be cap-

tured. In a discharge-based analysis, drug abuse comorbidity may lead to a reduction in measured costs; on a patient-level based analysis, costs are shown to increase for those with a drug diagnosis. Results from the inclusion and exclusion of tobacco abuse indicate that this facet is unimportant in this type of drug abuse study. Of course, tobacco use is indicated as a cost-increasing factor in many other health outcomes. Further work on the validity and reliability of diagnostic coding is also warranted and may be easily implemented in community sites. For the drug diagnosed, negative cost overlap with mental and alcohol disorders was found. Additional research is required on various subgroup disorders where there may be even greater cost problems. Finally, if drug treatment can be associated with the patient in the administrative records, readmissions can be easily examined as an outcome with a resulting greater potential for measuring cost savings to the health care system.

Reducing the numbers of drug diagnosed could be accomplished through a variety of interventions. For example, a primary intervention would be a referral to substance abuse treatment services. It is not possible to infer the adequacy of the referral made by clinicians in this study, and such a study should be encouraged. Referrals may be adequate but patients may not be willing to enter treatment, or patients may not be able to gain access to the treatment system, for any number of financial or capacity constraints. Work in this area would be fruitful, with potential savings available from reducing the high rate of readmission found in this study.

REFERENCES

Cartwright, W.S., Bisson, J.J., Cowell, C., and Kaple, J.M.: *NIDA Medicare Analysis System (NIDAMAS)*. NIDA Drug Services Research Series. To be published.

Cartwright, W.S., and Ingster, L.M.: The Effect of Drug Comorbidity on Length of Stay and Total Charges for the Medicare Population. NIDA Working Paper. To be published.

Fisher, E.S., Barton, J.A., Malenka, D.J., et al.: Overcoming Potential Pitfalls in the Use of Medicare Data For Epidemiologic Research. *American Journal of Public Health* 80(12):1487-1490, December 1990.

Iezzoni, L.I., Burnside, S., Sickles, L., et al.: Coding of Acute Myocardial Infarction: Clinical and Policy Implications. *Annals of Internal Medicine* 109:745-751, 1988.

McGuire, T.G., Dickey, B., Shively, G.E., and Strumwasser, I.: Differences in Resource Use and Cost Among Facilities Treating Alcohol, Drug Abuse, and Mental Disorders: Implications for Design of Prospective Payment System. *American Journal of Psychiatry* 144(5):616-620, May 1987.

Rice, D.P., and Kelman, S.: Measuring Comorbidity and Overlap in the Hospitalization Cost for Alcohol and Drug Abuse and Mental Illness. *Inquiry* 26(2):249-260, Summer 1989.

Rice, D.P., Kelman, S., Miller, E.S., and Dunmeyer, S.: *The Economic Costs of Alcohol and Drug Abuse and Mental Illness: 1985.* Department of Health and Human Services. DHHS Pub. No. 90-1694. Washington. U.S. Government Printing Office, 1990.

Regier, D.A., Farmer, M.E., Rae, D.S., et al.: Comorbidity of Mental Disorders with Alcohol and Other Drug Abuse. *Journal of the American Medical Association* 264(19):2511-2518, November 21, 1990.

Rosenheck, R., Massari, L., and Astrachan, B.M.: The Impact of DRG-based Budgeting on Inpatient Psychiatric Care in Veterans Administration Medical Centers. *Medical Care* 28(2):124-134, February 1990.