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LITHIUM REVISITED: SAVINGS BROUGHT ABOUT BY THE USE OF LITHIUM, 1970–1991

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Abstract

Background—Recent estimates of the cost of manic-depressive illness totaled roughly \$45 billion in 1991. Using data from the Epidemiological Catchment Area (ECA) study, this study estimates the savings brought about by the use of lithium between 1970 and 1991.

Methods—Total savings are the difference between estimated actual costs and projected costs had lithium never been introduced. Actual yearly costs were interpolated from data for 1970 and 1991, and projected costs were obtained by adjusting 1970 costs with Consumer Price Index (CPI) and population inflators. All costs for 1970 were obtained using methods almost identical to those used to calculate the 1991 costs of manic-depressive illness, presented in a previous publication. All savings are presented in 1991 dollars.

Results—Between 1970 and 1991, lithium saved over \$170 billion, or roughly over \$8 billion per year. Approximately \$15 billion in direct costs, which included inpatient and outpatient care as well as research, was saved between 1970 and 1991. The savings are more dramatic for indirect costs, which include the lost productivity of wage-earners, homemakers, family caregivers, and individuals who are in institutions or who committed suicide; these totaled roughly \$155 billion.

Conclusions—Our results suggest that, although manic-depressive illness is still costly, lithium has been tremendously successful in treating the illness, and has provided enormous financial savings in the process.

Keywords

lithium; manic-depressive illness; bipolar disorder; pharmacoeconomics; cost-effectiveness

INTRODUCTION

Manic-depressive illness (Bipolar disorder) will affect as much as 1.3 percent of the American adult population some time during their lives (1). Prior to the introduction of lithium, which was approved for use in the United States by the Food and Drug Administration (FDA) in 1970, individuals with manic-depressive illness often required months or years of hospitalization, experienced both a severe disruption in their social lives

and a loss of productivity, and frequently killed themselves. Lithium remains the mood-stabilizing drug standard and, although many individuals with manic-depressive illness remain untreated or are today treated with other agents, those who are treated with lithium often respond well and live remarkably improved lives. In a report written twenty years ago, we estimated the savings to the United States following the introduction of lithium through 1980 (2). Since that report was published, information has become available, primarily from the Epidemiological Catchment Area (ECA) study (3), which, among other things, gives an improved estimate of the number of affected individuals.

This study calculates the amount saved between 1970, when lithium was introduced, through 1991, by comparing the actual cost of manic-depressive illness to the estimated cost had lithium not been available, and calculating what proportion of the difference was due to lithium. 1991 was chosen as the end point because, after that time, use of alternate or adjunctive treatments for manic-depressive illness, such as carbamazepine and, more recently, valproate, increased. All amounts are in 1991 dollars.

It should be noted that our calculations are far from precise. In many cases, information was either unavailable, or only partially available, for specific costs for 1970. This required the use of, and adjustment of, data from other years. Similarly, only a limited amount of information was available on the number of manic-depressive patients in the United States in 1970, the actual number in treatment, their average length of stay in a hospital, and their basic pattern of treatment (including number of hospitalizations, outpatient visits, and loss of work time). Although every effort was made to obtain figures from 1970, much of the data were rudimentary and a number of broad statistical and methodological assumptions were necessary in order to derive our cost estimates. The goal of this study, then, was to provide a rough, rather than precise, estimate of the savings brought about by lithium use; we believe such a breakdown in savings has major implications at a time when medicine must be cost-conscious as well as concerned with quality of care.

METHODS

Actual, Projected, and Savings Estimates

The estimates were made using three basic calculations: an estimate of actual costs, an estimate of projected costs (the cost had lithium never been introduced), and the difference between those numbers, which yielded total savings. Actual 1991 costs were available (4), and actual costs for 1970 were calculated using the same techniques used to estimate 1991 costs. It was assumed that lithium provided no benefits in 1970. Actual costs for the intervening years, with the exception of Department of Defense costs, were based on linear interpolation of data from 1970 and 1991. In 1970, due to the Vietnam conflict, the number of Department of Defense active duty personnel was much higher than in 1991. Department of Defense costs were therefore estimated based on the actual number of active duty servicemen for each year (5). Although none of these processes are completely linear, data compiled from annual pharmacy prescriptions indicate that lithium use in the United States rose in a linear fashion from at least 1975 to the present (6). Furthermore, because we were interested in the total savings over this period, the over- and under-estimates of a linear fit tended to cancel each other out.

Projected costs were obtained by adjusting actual 1970 costs with population inflators as well as the appropriate Consumer Price Index (CPI) inflator (medical care, hospital room, or all items) through 1991 (7). Total savings are the sum of the savings for each year, converted into 1991 dollars, and presented in direct and indirect cost components.

Because other advances have been made in the treatment of manic-depressive illness since 1970, lithium cannot account for all of the observed savings in manic-depressive illness. In order to determine the savings due to lithium, we used data on lithium response rates (8–11). Rigorous studies over the past 40 years involving hundreds of patients have repeatedly shown that roughly 80 percent of manic-depressive individuals respond to lithium, and so we attributed 80 percent of the totaled savings between 1970 and 1991 to lithium. Because not all those who respond to lithium experience a complete response, we adjusted these figures in a sensitivity analysis (see Discussion) in order to establish a range of probable savings due to lithium. Furthermore, although other mood stabilizers such as carbamazepine and to some degree valproate were used before 1991, either alone or in conjunction with lithium, their use was probably not widespread enough to significantly impact cost savings (12); valproate did not receive FDA approval for use in manic-depressive illness until 1995.

CPI Adjustments

For many of our calculations, specific costs for 1970 were not available, and data from other years were adjusted and used. There are several reasons to use the CPI index to adjust and, more importantly, to forecast projected costs. First, because costs were the focus of this study, we felt that an indicator of inflation would most accurately reflect changes; this makes the CPI appropriate. Had we been interested in the current worth of savings, a different adjustment process, such as interest rates, might well have been preferable (see Discussion). Second, using the CPI index is consistent with similar studies in this field (13).

When such adjustments were necessary, direct costs for the year closest to 1970 for which data were available were adjusted to 1970 values by the appropriate CPI (7). Direct costs for hospitals were adjusted using the CPI for the cost of hospital beds (a number that was higher than the Medical Care CPI). Because indirect costs were more difficult to sort into their appropriate index components, the CPI for all indexed items was used.

Diagnostic Issues

In the United States, the diagnosis of manic-depressive illness has changed considerably since 1970. Many individuals who would have been diagnosed with schizophrenia in 1970 would today receive a diagnosis of manic-depressive illness. Several studies around 1970 showed that underdiagnosis of manic-depressive illness was a real and serious problem in the United States. A 1969 study at a Brooklyn hospital showed that fully two-thirds of a group of patients who clearly fit the diagnosis of manic-depressive illness had been diagnosed as schizophrenic by the hospital staff (14). This issue became extremely important with the emergence of lithium as a successful treatment for manic-depressive illness (15). For the calculation of projected costs, the recorded 1970 number of patients was increased, based on data from a study by Gurland and colleagues (1969), by a factor of three to correct for the “missing” manic-depressive individuals. Because all projected costs were

based on the calculation of the cost for 1970, the above correction was carried through in the calculation of costs for all subsequent years. We have included results of a sensitivity analysis on this subject in the Discussion.

In addition, many data sources did not distinguish between manic-depressive illness and the more broadly defined and inclusive diagnosis of affective disorders. When published studies lumped data for all affective disorders, a ratio of one third was used to determine specific costs for manic-depressive illness (manic-depressive illness versus major depression plus manic-depressive illness [2.2/6.6]), based on data presented by Weissman and colleagues (1991).

RESULTS

Direct Costs

With few exceptions (described below), 1970 direct and indirect costs were estimated in a manner consistent with 1991 cost calculations (4). Administrative and lost opportunity capital costs were included when applicable (16). Direct costs were assessed for the categories detailed below (the exclusion of certain categories is explained in further detail in the Discussion). Actual costs, projected costs, and savings totals are given in Table 1.

Total Inpatient Care—In 1984, a major resource, Mental Health United States (17), redefined the way certain costs were classified because of changes in government policy (see “Shifting of Costs,” in the Discussion). This made data interpretation somewhat more difficult; for instance, specific data for Multiservice Hospitals were collected in 1991, but not in 1970. Costs for Multiservice Hospitals therefore appear to be much larger in 1991 than in 1970, when, in fact, a shifting of costs occurred rather than an increase. Because we were interested in totaled savings more than individuals components, we did not attempt to reallocate costs to their proper category. Thus, examining aggregated inpatient and outpatient costs provides a clearer picture than viewing these components separately. Costs were assessed for Private Hospitals, State and County Mental Hospitals, Veterans Administration Hospitals, Non-Federal General Hospitals, Multiservice Hospitals, the Indian Health Service, and the Department of Defense.

Total Outpatient Care—Although case management services were a cost in 1991, it was assumed that these costs were minimal (and essentially did not exist) in 1970. The process of deinstitutionalization and the success of lithium, however, created a manic-depressive population treated on an outpatient basis in ever-increasing numbers. To obtain actual case management costs, we assumed that there was a linear relationship between the 1991 cost and the 1970 cost (which was \$0) and interpolated the values in between. This undoubtedly overestimates the impact of lithium, since some form of case management did exist in 1970, and since lithium was not the sole reason for the increased use of case management services over the period of interest. As for hospital-based outpatient expenditures, these are usually included under inpatient care expenditures because most hospital data do not separate the two. This does not affect the totals, but it shifts some outpatient costs to inpatient expenditures. Costs were assessed for Private Care, Freestanding Outpatient Clinics,

Federally Funded Community Mental Health Centers, Veterans Administration, the Department of Defense, the Indian Health Service, and Case Management.

Nursing Home and Related Care—To estimate the cost of nursing home care for 1970, the 1977 prevalence of manic-depressive patients in nursing homes was used. It is interesting to note that this number (3.3 percent) was considerably lower than the 1991 prevalence of manic-depressive individuals in nursing homes (9.7 percent) (18,19). Because the policies associated with deinstitutionalization were already firmly in place by 1977, this change may be at least partially related to the success of lithium in the treatment of manic-depressive patients, assuming it led to the release of more of these patients from state hospitals into alternate care facilities, including nursing homes. In addition to traditional inpatient and outpatient care, the Veterans Administration operates intermediate care beds and domicilliary care facilities. Savings were calculated for these as well.

Supported Living and Shelters—Surveys differ greatly on the number of individuals who are mentally ill and homeless. The cost of shelters, which provide a number of services not found in ordinary housing, have thus far not been included in these estimates. Although supported living arrangements and shelters existed in 1970, the number and cost of these facilities could not be estimated. It was assumed that, in 1970, these costs would have been almost invisible, but growing, because as deinstitutionalization continued, the number of shelters accommodating individuals with mental illness grew, as did the number of shelters themselves. We reviewed several studies on the prevalence of mental illness in the shelter population (4) and made the conservative estimate that in 1991, manic-depressive individuals comprised 4.4 percent of this population. In the present calculations, it was assumed that the number of manic-depressive individuals using shelters grew linearly from zero (and the associated cost of \$0) in 1970, to 4.4 percent (and its associated cost) in 1991.

Medication—The cost of medications used to treat manic-depressive illness in most inpatient, other institutional, and some outpatient settings have been included as part of the aggregate expenses in the appropriate sections. Nevertheless, patients and family members pay a considerable percentage of the outpatient expenditure for medications not included in previous estimates and not covered by other expenses or insurance (20). For 1970, it was assumed that manic-depressive patients who were being treated with medications were given antipsychotic medications rather than lithium (although some were probably being treated with electroconvulsive therapy (ECT), minor tranquilizers, and various forms of psychotherapy). To obtain a rough estimate of the number of patients with manic-depressive illness in the community receiving antipsychotic medications, the number of hospital beds for patients with manic-depressive illness was doubled, likely a conservative estimate. This number was multiplied by the annual cost of antipsychotic medications per patient in 1970 to obtain the total cost, which was then carried forward in the projected cost calculations.

Research Costs—In 1970, the National Institute of Mental Health spent roughly \$6 million in intra- and extramural funds on research into affective disorders (21). In order to calculate how much of that was spent on research into manic-depressive illness, the previously derived 2.2/6.6 ratio was used (see Diagnostic Issues). It was assumed that states

and private sources contributed another \$1 million, for a total of \$3 million. By 1991, research into manic-depressive illness from all sources had increased to approximately \$47 million.

Suicide—Only the direct costs of suicide, such as medical costs for attempted suicides, and investigational costs for completed suicides, are considered here; lost productivity is discussed under indirect costs. A careful review of suicides and attempted suicides highlights how lithium decreases mortality among patients with affective disorder, a diagnosis that is less restrictive than manic-depressive illness. Tondo, Jamison, and Baldessarini (1997) found the risk of suicide per 100 patient years was 0.39 when patients were receiving lithium, and 2.2 when they were not (22). Several, but not all, recent studies have found evidence that lithium decreases mortality among manic-depressive individuals. In our analysis of these studies (23–29), we found that lithium prevented suicidal behavior in the majority of manic-depressive patients. The rate of completed suicides for manic-depressive individuals taking lithium is approximately three percent (see Table 2). In contrast, the suicide rate for manic-depressive individuals not taking lithium is approximately 19 percent (28).

INDIRECT COSTS

The simplest definition of indirect costs is that they represent lost productivity—lost earnings or wages which are either a direct or indirect result of manic-depressive illness. Individuals age 65 and over were not included since, had they been healthy, many would be retired and no longer compensated for their work. Actual cost, projected cost, and savings totals are given in Table 1.

Lost Wages

Lost wages include those from family members of individuals with manic-depressive illness who either could not work at their full capacity or could not work at all because they needed to take care of their sick family member; the lost wages of either partially or totally disabled manic-depressive homemakers; the lost wages of individuals with manic-depressive illness who were in institutions; and the lost wages of those who committed suicide.

The lost wages of family members were calculated by estimating the number of hours spent annually with a sick family member and then determining the economic value of that time (30). This may overestimate the costs, and hence artificially increase the savings, since not all of this time would have been spent productively (some would be leisure time). The only comprehensive estimate for the time that families spent with patients came from a study containing data on schizophrenic patients from the mid-1980s, but recent studies have shown that manic-depressive individuals are likely to consume equal amounts of their families' time (31).

The lost wages of homemakers were calculated by estimating the number of manic-depressive homemakers, based on the number of homemakers in the general population. The estimated lost productivity of homemakers was calculated somewhat differently in this study for both 1970 and 1991 than in the original 1991 study of the cost of manic-depressive

illness. This was due to lack of similar data between the two years, forcing us to adopt an alternate method. This difference did not significantly affect the results.

We also estimated the lost wages of manic-depressive individuals in psychiatric institutions, shelters, nursing homes, jails and prisons. In 1970, there were approximately 129,000 manic-depressive individuals between the ages of 18 and 65 occupying beds in these institutions. During their stay, these individuals could be considered nonproductive. Because our other estimates of lost productivity were based on household samples, they did not take most institutionalized individuals into account.

Finally, we took into account the lost earnings of those individuals who committed suicide. In 1970, before the introduction of lithium, approximately 16,500 manic-depressive individuals committed suicide each year. Lithium dramatically decreased the suicide rate for manic-depressive individuals (22) (see Table 2). Our analysis suggests that lithium may have saved over 30,000 lives since it was introduced.

Lost Earnings

Lost earnings include the compensation received by adult manic-depressive workers who were not working (and who would have been working had they not been ill), and those who were working but were partially disabled by their illness. These savings are likely to be lower than those produced in reality because some of the data on the prevalence of skilled and unskilled manic-depressive workers were based on 1980 figures. These numbers inherently reflect lithium use by the manic-depressive population. One assumes that without lithium, at least some percentage of these individuals would be significantly less productive.

DISCUSSION

Direct and indirect savings from lithium in the United States between 1970 and 1991 were approximately \$170 billion dollars (see Table 1). This estimate demonstrates the economic importance of lithium in treating manic-depressive illness. It should, however, be acknowledged that these numbers lack surety. Some of the limitations of this study are described below.

Deinstitutionalization

The present calculations assume that, at least for the manic-depressive population, the deinstitutionalization of patients occurring in the 1970s, as well as the associated savings, were due to lithium. Because deinstitutionalization occurred for many other reasons, this assumption overestimates the impact of lithium. This overestimate, however, is in part negated by cost shifting issues (see “Exclusions” and “Shifting of Costs” below), and by the fact that we attributed only 80 percent of the totaled savings to lithium.

Exclusions

Although there were estimates for both the 1970 and 1991 direct costs of crime, the direct costs of caring for manic-depressive individuals in jails and prisons, and the direct costs of substance abuse, these are not included in the totaled savings. Between 1970 and 1991, these

costs rose far more rapidly than could be explained by either inflation or population increases. Because of this rapid rise in costs, we could not determine whether there was actually a reduction in these expenditures for the manic-depressive population. It was therefore decided to exclude these costs from our analysis, because we were not comfortable with any assumptions we could have made to clarify this matter. This is likely to lead to a more conservative estimate of actual savings, since lithium has, in all likelihood, reduced these costs.

Shifting of Costs

Although lithium was expected to produce savings in all areas, results of this study show that this was not the case (Table 1). Multiservice hospitals, nursing homes, shelters, case management, medications, and research became more costly. These expenses can, in part, be attributed to a shifting of costs between categories over these two decades. For example, in 1991, approximately six percent of all Multiservice Hospital beds were used to treat manic-depressive patients (32). In 1970, however, there were fewer Multiservice Hospitals, and those that existed were lumped by *Mental Health United States* into a category called “other” (19). The reason for the growth of Multiservice Hospitals can be attributed to policy changes enacted in 1984, and does not affect aggregated health care totals for lithium savings. This shift in classification also affected data for Federally Funded Community Mental Health Centers (17).

Similarly, as lithium proved efficacious in the treatment of manic-depressive illness and the number of state hospital beds for these individuals decreased, the need for shelters, nursing homes, and case management for this population increased.

The greater cost attributable to medications is due to a conservative approach and to how costs were grouped. Although lithium itself was a small cost, it was assumed that non-institutionalized patients maintained on lithium have their lithium blood levels drawn six times a year, and have a thyroid screen (thyroid stimulating hormone or TSH) biannually. Such testing increases the cost of medication treatment. In contrast, it was assumed that, in 1970, patients with manic-depressive illness were largely being treated with antipsychotic medications, most likely given in the hospital and hence included in the costs of hospitalization. If the projected medication costs were to include hospital inpatient in addition to outpatient costs, there is little doubt that the savings from lithium in this area would be greater.

Sensitivity Analyses

Because certain potentially controversial assumptions and simplifications had to be made to derive these numbers, three sensitivity analyses were run to check the robustness of the results.

Analysis One: Number of Manic-Depressive Patients in 1970—One of these was the factor of three used to obtain the “true” number of manic-depressive patients in 1970. This number was based on the only data available. If a more conservative estimate of this underdiagnosis were made, and the recorded number of manic depressive patients were

multiplied by two rather than three (thereby assuming that one-half rather than two-thirds of manic-depressive individuals were misdiagnosed), total savings fall to \$149 billion. On the other hand, if the recorded number were multiplied by four (thus assuming that three-fourths rather than two-thirds were misdiagnosed), savings increase to \$193 billion. Although these changes are large on a dollar scale, they do not affect the scope of the results.

Analysis Two: Use of the CPI to Adjust Costs—A second issue is the concern that the CPI is less appropriate for adjusting saved 1970 dollars into 1991 dollars than it is for projecting 1970 costs forward. Thus, it is possible that taking the savings from lithium for each year and using interest rates to determine cumulative savings in 1991 may be a more realistic estimate of these savings. Because interest rates tend to be larger than inflation, although they differ widely among themselves, such an assumption increases the estimated savings. For instance, if the federal funds effective rates between 1970 and 1991 were used to “invest” the savings from each year, savings in 1991 would be \$228 billion; this is a significant dollar increase in the financial savings.

Analysis Three: Efficacy of Lithium—The third sensitivity analysis was run in order to discover how different assumptions about the efficacy of lithium impacted the results. Although this study made no assumptions concerning the efficacy of lithium in treating manic-depressive individuals in 1970, this issue is inherently reflected in the numbers from 1991. Actual 1970 costs assume that lithium was not making a difference in the lives of these individuals (to a small extent, that underestimates the savings because some patients were already receiving lithium) and projected costs similarly assume that lithium had never been introduced. Nevertheless, this issue is distinct from that of response rate to lithium and therefore how much of the observed savings between 1970 and 1991 come from lithium alone. Because improved treatments for manic-depressive illness over the years have included carbamazepine, psychosocial interventions, deinstitutionalization and, more recently, valproate, our study assumed that, of the total savings after 1970, roughly 80 percent were attributable to lithium. This is based on observation, as well as on available data (8). Although not all 80 percent of those who respond to lithium have a 100 percent response to it, our estimate of the 1991 costs already assume that many individuals with the illness are not functioning at their full capacity. Other studies have suggested that only between 60 and 80 percent of individuals with manic-depressive illness respond to lithium (33,34); thus, if we assume instead that only 60, rather than 80, percent of savings arise from lithium use, then we reach the more conservative conclusion that lithium saved \$130 billion since 1970. If we make the even more conservative estimate that only 50 percent of savings came from lithium, then we reach a total of \$108 billion in lithium savings. Even assuming this reduced effect, these numbers remain significant enough to impart the enormous impact lithium has had in treating manic-depressive illness. To some degree, whatever estimate is used for calculating the effectiveness of lithium, it would in some part be offset by lithium’s value in treating other psychiatric illnesses, such as schizoaffective disorder.

Retrospective Nature

Because of numerous methodological issues, retrospective cost studies of psychiatric care such as this one, which cover many years and use data derived from diverse sources, are

likely to be incomplete and are subject to considerable error. Some of the data used in calculating 1970 costs were derived from later estimates. Using post-1970 cost estimates for manic-depressive illness, and extrapolating them back to 1970 to estimate projected costs provides a conservative estimate of savings because costs for the illness have been decreasing since then.

Similarly, although the 1991 actual cost estimates were based on the most recent available information, they often required extrapolation from a prior, or base, year. Adjusting data from a base year to 1991 could inflate 1991 actual costs if increased awareness about manic-depressive illness and effective treatment for it caused a larger percentage of affected individuals to seek treatment. This would also underestimate the savings.

Advantages to This Study

Most studies of the costs of affective disorders, including our own prior paper estimating the savings from lithium, have covered the more traditional aspects of indirect costs: lost wages from individuals in the work force, or the wages lost from those who committed suicide as a result of their illness (2,13). This study included more extensive estimates of indirect costs, such as the lost wages of homemakers, the lost wages of manic-depressive individuals in institutions, and the lost wages of the families of manic-depressive patients who had to take time off from work to care for, or seek care for, their ill relative. Inclusion of these aspects gives a more complete picture of the economic burden of manic-depressive illness, and highlights the role that lithium has played not only in lessening that financial burden, but in improving quality of life.

Disadvantages to This Study

Although the accepted method of adjusting for changes in medical costs has been use of the Medical CPI, it has recently been suggested that this indicator has an upward bias that unnaturally inflates costs. Research on pharmaceutical industry pricing indicates that the methods used by the government to estimate price growth in this sector may be biased, thus affecting medical care totals. Under such circumstances, use of the All Items CPI would be a better indicator of monetary value when evaluating medical costs (13). If this is indeed the case, savings in inpatient and outpatient care in this paper would have been overestimated, because we used the Hospital Bed CPI and the standard Medical CPI, respectively, to arrive at these totals.

Another disadvantage to this study is that only two time points (1970 and 1991) were used, while all other data were interpolated from them (with the exception of active duty personnel in the Department of Defense); this assumed a linear relationship to these estimates. Although available data regarding lithium prescriptions suggest that such a linear relationship is accurate (6), if sufficient data were available for more years, the conclusions would be more precise. It is also possible that simply projecting 1970 costs with CPI indices may not be an accurate description of what current costs would be had lithium never been introduced; however, given the available data and its uncertainty, this is as useful and correct an estimate as possible.

CONCLUSION

The economic benefits due to lithium for manic-depressive individuals, their families, and society are sizable. This study has presented only the economic value of lithium and has not attempted to quantify the value of lithium in easing the often painful mood swings of manic-depressive patients or in relieving the emotional burden of that person's family and caregivers. We examined only the financial impact of this medication, although productivity values may, to an extent, reflect quality of life for these individuals and their families. Despite the limitations above, the total estimated figures presented in this paper provide additional dimension and perspective through which to ascertain the benefits resulting from the introduction of lithium into the United States in 1970.

In most categories included in our analysis, lithium lowered the costs of treating manic-depressive patients between 1970 and 1991. Hospital costs, for example, decreased noticeably during this time period. Some categories show only modest savings; in other categories, such as inpatient care or indirect costs, especially from suicide, the savings are particularly impressive. Lithium saved close to \$170 billion, or an average of over \$8 billion per year, between 1970 and 1991 (all results in 1991 dollars).

There was a significant increase in research expenditures between 1970 (\$3 million, or roughly \$10 million in 1991 dollars) and 1991 (\$47 million). In part, this reflects a general increase in biomedical research funding, as well as current awareness of the value of mental health research because of many noteworthy recent achievements. And although these numbers are only estimates, they demonstrate how the cost of diseases such as manic-depressive illness can be reduced, and large savings in human and economic terms realized, when effective treatments are found.

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TABLE 1

Total Savings from Lithium, 1970 to 1991 (in 1991 Dollars)

Category	Projected Costs, 1970—91 (in millions)	Actual Costs, 1970—91 (in millions)	Total Savings, 1970—91 (in millions)
DIRECT COSTS	\$115,975	\$100,535	\$15,440
Inpatient and Outpatient Costs			
State and County Hospitals	36,400	19,890	16,510
Private Hospitals	17,585	14,785	2,800
Veterans Administration Hospitals	10,580	5,440	5,140
Veterans Administration (Domiciliary and Intermediate Care)	200	150	50
Non-Federal General Hospitals	15,220	12,335	2,885
Multiservice Hospitals and Freestanding Partial Care Centers (Other 1970 Category)	2	3,555	-3,555
Indian Health Service, Inpatient and Outpatient	40	35	5
Department of Defense, Inpatient and Outpatient	520	380	140
Outpatient Costs (Veterans Administration, CHAMPUS, Federally Funded CMHCs, Freestanding Outpatient Clinics)	8,580	5,210	3,370
Nursing Homes, Shelters and Case Management	21,060	32,985	-11,925
Medications	620	1,375	-755
Research	205	500	-295
Suicide (Direct)	4,960	3,895	1,065
INDIRECT COSTS	\$838,200	\$682,985	\$155,215
Lost Earnings	322,380	296,665	25,715
Lost Productivity (Caregivers)	164,065	127,260	36,805
Lost Productivity (Homemakers)	39,880	32,565	7,315
Lost Productivity (Institutionalized)	72,145	57,060	15,080
Lost Wages from Suicide	239,730	169,430	70,300
TOTAL	\$954,175	\$783,520	\$170,655

TABLE 2

Rate of Completed Suicides in Manic-Depressive Patients Using Lithium

Study	Number of Patients	Number of Suicides	Suicide Rate
Muller-Oerlinghausen, et al., 1992	55	1	1.8%
Vestergaard, 1991	61	5	8.2%
Coppen, et al., 1991	30	0	0
Muller-Oerlinghausen, et al., 1991	423	6	1.4%
Page, et al., 1987	65	6	9.2%
Goodwin and Jamison, 1990 ^a	586	7	1.2%
Weeke, 1979	222	22	10%
WEIGHTED SUICIDE RATE IN PATIENTS TAKING LITHIUM			3.26%

^aReflects an amalgamation of several studies listed in *Manic-Depressive Illness*, pp. 237–239. Note that the data reported by Tondo and colleagues (1997) are largely for patients with a diagnosis of affective disorder, a diagnosis that includes manic-depressive disorder and unipolar disorder, although it is unlikely many of the unipolar depressed patients were being treated with lithium. In that study the suicide risk ratio was 5.64 (untreated to treated) while in the present study, using only patients with manic-depressive illness, it was 5.83.