Medication Adherence and Compliance: Uncontrolled Variables in Psychiatric Clinical Drug Trials

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Abstract

Over the past decade, there have been thousands of controlled clinical trials assessing the efficacy and safety of drugs used to treat a range of illnesses. The purpose of this review is to document how often medication adherence is controlled in pharmaceutical drug research. Authors of this study focused specifically on psychiatric drugs and clinical drug trials between the years 2002 and 2012. The automated searches included the use of search engines designed to scan documents for key words; limits were set to narrow the search queries to human subjects, clinical drug trials, and publications within the past 10 years (2002 to 2012). Databases reviewed included: PubMed / Medline, Science Direct, Scirus, and Scopus. The variable, control for adherence, occurred in a low frequency among articles published, and statistical significance was found between drug classes as well as queried search phrases that examined adherence versus compliance. Overall, mention of control for adherence or compliance is missing in a significant and large portion of published articles involving clinical drug trials. The results revealed that the majority of articles written, across all four databases and all seven drug categories, did not control for medication adherence and compliance. At the conservative end, results show that approximately 67% of articles on clinical drug trials neglected to mention or control for compliance. Results call into question the validity of clinical drug trial claims, as well as the safety and efficacy of pharmaceuticals in psychiatric practice.

Introduction

In a recent study, Gottlieb, Corrado and Griswold identified the lack of control for adherence and non-compliance to drugs as serious impediments to clinical drug studies [1]. These authors concluded that the lack of control for adherence compromises the safety of patient populations for which specific drugs are tailored. Gottlieb and colleagues focused on four drug categories: antidepressants, antipsychotics, antivirals, and analgesics. Their results raise concerns regarding the lack of measurement of adherence and compliance in clinical drug studies. They showed that the majority of published drug studies over the last 12 years neglected to control for medication adherence. They also noted that, "...despite the current FDA regulations (1997) on clinical drug trials, which mandate the investigator to monitor patient adherence to the treatment regimen, there is a low percentage of studies that even attempted to address the issue of adherence" [1]. According to Gottlieb et al. [1] among the publications that addressed adherence, some merely mentioned adherence without any attempt to control for it. Gottlieb et al. also conducted both manual and automated searches and compared the hit rates of the two procedures. The automated and manual search of studies yielded different results (3%-9% vs. 15.2%, respectively); however, the overall frequency of publications in which adherence was mentioned was extremely low under either search method.

In consideration of the fact that Gottlieb et al. focused on only four drug classes and used specific databases, this study is designed to build and improve upon the former with a more exhaustive use of databases, tailored for the health sciences. Secondly, the present study included seven psychiatric drug categories: antidepressants, antipsychotics, anticonvulsants, anxiolytics, stimulants, opioids, and mood stabilizers. Although the Gottlieb et al. study showed that the majority of clinical drug trials do not control for adherence and provided valuable insight into pharmacological safety, the study had serious limitations. For example, their publication lacked advance statistical analyses, neglected to include tables or graphs, and showed inconsistencies in search phrases and limiters applied to the queries. Lastly, their study neglected databases that may contain articles pertinent to psychiatric drug research such as Scirus or Scopus.

In order to mitigate the limitations of the former study, more thorough and multilevel analyses were attempted in the present study. One caveat, the present authors refrained from manual searches and focused exclusively on automated searches.

Before examining the results of this present study, a quick review of some of the factors that influence non-adherence and non-compliance will be provided. Patient variables such as cognitive factors, disease progression, side effect profiles, drug interactions and therapeutic alliance are among many that confound and complicate the measurement of medication adherence (D. Turk, personal communication, March 2011) [1].

First, a review of the terms adherence and compliance is appropriate. The terms adherence and compliance, although sometimes defined in different ways, are used interchangeably in the literature reviewed. Treatment adherence is defined as the extent to which a person's behavior coincides with medical or mental health advice. Adherence suggests an active patient role; a willingness to participate. Adherence also implies consistency with a prescribed regimen; it is analogous to joining or attaching oneself to something. In contrast, the term compliance
implies a more passive patient role. Compliance characterizes the patient as acquiescing, resigning or relinquishing authority to another [2]. The latter point becomes more salient when comparing the hit rate percentages between the key search words, adherence vs. compliance, in the scientific literature. It can lead to conjectures and discussions on how prescribers view patients.

Non-adherence to treatment recommendations was estimated at 40%, with some studies showing that it may be as high as 75%; an average non-adherence rate was estimated at about 50% [3-5]. Turk approximated that 67% of patients receiving new written prescriptions each year will show either partial or complete non-compliance [6]. A review of the World Health Organization (WHO) publications revealed that 50% of patients diagnosed with chronic disease adhered to recommended treatments; the implications of this finding include the fact that nearly half of medication treatment recipients do not adhere or comply with medication protocols. Undoubtedly, such statistics warrant more research and demand attention to the efficacy and safety of pharmaceuticals [7].

Other studies confirm the low adherence trends involving synthetic antidepressants. According to Ellen et al. [8] as many as 50% of clinical drug trial participants drop out or cease medication after 3 months. Such a high mortality rate in clinical research is problematic and confounds the generalizability of statistical findings. One might also infer that pathology and severity of illness modulate adherence rates. As an example, Miklowitz and Johnson [9] showed that nearly 60% of patients diagnosed with bipolar disorder discontinue treatment within the first year. Lack of adherence in patients with BD may be related both to the side effect profiles of drugs and to the symptoms of the disorder. In fact, past studies have shown patients with BD show similar, low levels of non-adherence and poor compliance [10].

**Patient-centered variables**

It is reasonable to foresee that as drug dosages increase, treatment adherence decreases [4]. These findings suggest that more frequent dosing corresponds to less patient adherence. Cognitive variables such as a patient’s locus of control with regard to treatment adherence should be evaluated. As stated by Gottlieb et al., non-adherence could be a function of factors such as perceived or real decreases in disease progression or symptomatology, perceived helplessness, defense mechanisms such as denial, motivational apathy, and lack of family or financial support. Patients have been known to alter their medication-taking patterns based on a “feel good” rate or “wisdom of the body” rule; some stop their medication intake all together after experiencing symptomatic relief [1,2].

Studies have shown a correlation between dosage frequency and drug compliance; with higher dosages negatively correlated to rates of compliance [11]. A patient’s perception of drug efficacy and side effects also correlate strongly with lack of adherence [2]. In one study, Zhang et al. found that patients diagnosed with schizophrenia and provided augmentation with natural / homeopathic remedies, in conjunction with antipsychotics, showed markedly improved rates of adherence as compared to the non-augmented medication group. A similar finding was uncovered when patients with BD given only pharmacotherapy were compared to patients provided pharmacotherapy and psychotherapy combined. Patients in the latter group had higher rates of adherence [12].

In the drug classes of anxiolytics and opioids, and arguably stimulants, lack of adherence may be characterized by over-medicating as opposed to under-medicating. Opioids naturally run the risk of addiction in vulnerable patient populations [13]. Many pain patients experience common phenomena such as drug tolerance or dependence. These are also typical signs of early drug addiction [14]. The strong psychological components that add to the phenomena of addiction are important in learning how to unravel the mind-body connection, especially, when pharmaceuticals are involved [13]. Anxiolytics like the benzodiazepines and stimulants, such as those prescribed for the treatment of ADHD, are often abused and pose both legal and ethical problems for patients and their prescribers. Cognitive factors are difficult to quantify but important in considering adherence or non-adherence behavior. More detailed examination of psychological variables may help scientists develop evidence-based programs to increase medication adherence / compliance.

Psychological reactance, a cognitive phenomenon, plays a role in whether patients collaborate or behave as passive spectators in their medical care [15]. When patients feel usurped by the physician regarding their treatment plan, the patient’s commitment to treatment adherence weakens. Likely, this extends to the patients’ view of the therapeutic alliance as well. Patients are not as willing to adhere to their medical regimen when they are not given an opportunity to actively participate in decision making [15-17]. Patient Controlled Anesthesia (self-administering of pain medications) illustrates the phenomenon. Patients allowed control over their medication administration and dosages are less likely to use or overuse medications as compared to patients whose medication is regulated by a physician or nurse [18]. It is well established that patients offered a collaborative role in decision-making are more likely to conform to medical recommendations and treatment regimens [16].

Successful evaluation of therapeutic outcomes is partially contingent on the assessment of adherence; treatment compliance is critical to understanding several factors including the efficacy and safety of prescription drugs. There are limited clinical studies focused on patient adherence in clinical drug trials, and few investigations have evaluated strategies for enhancing patient participation [19].

The FDA has set forth clear and explicit guidelines by which clinical pharmaceutical trials are expect to be conducted; it is presumed that the majority of clinical drug trials identify the issue of adherence when interpreting the results [20]. However, adherence is quite possibly a variable that is overlooked. The overall purpose of this present study is to determine whether clinical trials involving psychiatric drugs (e.g., antidepressants, anxiolytics, antipsychotics…) are, in fact, controlling for adherence weakens. Likely, this extends to the patients’ view of the therapeutic alliance as well. Patients are not as willing to adhere to their medical regimen when they are not given an opportunity to actively participate in decision making [15-17]. Patient Controlled Anesthesia (self-administering of pain medications) illustrates the phenomenon. Patients allowed control over their medication administration and dosages are less likely to use or overuse medications as compared to patients whose medication is regulated by a physician or nurse [18]. It is well established that patients offered a collaborative role in decision-making are more likely to conform to medical recommendations and treatment regimens [16].

Since the issue of medication adherence is so widespread and a problem variable in research, it is not surprising that the U.S. Department of Health and Human Services offers grants towards program development to improve medication adherence. Currently, the U.S. DHHS has funds allocated towards research into improving adherence in several patient populations (e.g., adolescents) [21]. The information is welcomed and should provide some answers as to developing a multimodal and effective method of increasing patient compliance.

**Rationale**

Based partially on the Gottlieb et al. study and the current literature, it is our assumption that if authors of published clinical trial studies, in peer-reviewed journals, attempted to control for adherence
or compliance, the word itself (adherence or compliance) would be mentioned somewhere in the anatomy of the publications. A brief manual review of some of the articles queried showed that not all articles which contained the word adherence, as an example, actually measured for treatment adherence. Rather, the word was used anecdotally in reference to past studies or issues with adherence, not in an attempt to measure or control for it. This is important to keep in mind and should be considered as in future studies of this nature.

For this study, a review of clinical drug studies published over the last 10 years was conducted by automated searches via electronic databases, selecting some of the most widely used databases at research universities and across clinical settings. Searches were narrowed to publications focused on the following drug categories: antipsychotics, antidepressants, anticonvulsants, anxiolytics, stimulants, opioids, and mood stabilizers. These medications are common and widespread in both clinical drug trials and psychiatric practice.

In clinical drug studies, when measurement of adherence is unaccounted for, the interpretation of results and evaluation of drugs' efficacy may be compromised [22]. This is a review of the need for consistent control or measurement of medication adherence in clinical drug trials.

Methods

Procedures

This study incorporated the use of electronic database searches to locate specific keywords found in all fields containing articles and books. As an example, if any of the words typed into the key word phrase were located anywhere in the anatomy of the article or book (e.g., abstract, methods, results, discussion, etc.), that title was included in the results yielded and analyzed. For each of the four database studied, specific limiters were included while key word phrases were matched and exactly the same across all database searches.

Databases selected

We selected four major databases for this study. The databases are listed as: (1) Pub Med / Medline, (2) Science Direct, (3) Scirus, and (4) Scopus. These are some of the most commonly used databases and electronic search engines among college students and researchers in the health sciences. Students in the health and behavioral sciences utilize libraries and e-databases with which they are familiar. Tenopir and Read surveyed college students and doctoral researchers and found that 75% of undergraduates, 90.5% of master level students, and 83.3% of doctoral students used databases upon which they were specifically trained [23]. According to one study, Medline boasts a sensitivity rate of 72% and a specificity rate of 75% with regard to hit rates on articles in narrowly focused domains of research [24]. Gottlieb and colleagues showed that when compared to EMBASE, BIOSIS, LILACS, Medline yielded 20% of non-replicated studies when reviewers searched the "prevalence of maternal mortality and morbidity from 1997 to 2002" [1]. Since this present study involves the use of specific keyword phrases in popular electronic databases, such statistics are useful in justifying the strengths of certain e-databases over others. In health science related academic studies, authors suggest that pilot database searches begin with Medline and then extend into other databases [25]. Interestingly, the results of the present study showed PubMed, which accesses Medline, to have the lowest hit rates of clinical drug trial articles containing the words adherence or compliance.

Authors set the final search parameters for the automated search and limited the electronic database search to peer-reviewed, journal articles and books related to clinical drug trials, conducted between 2002 and 2012. Although very few differences exist between databases in terms of limiter / parameter settings, mild differences in parameter settings and online templates require that each database be reviewed independently and that the reader is made aware of the slight variations in limiter settings found. Thusly, what follows shortly will include a review of the search query methods specific to each of the four databases.

Also, the electronic database searches were limited to the following drug classes: (1) antidepressants, (2) antipsychotics, (3) anticonvulsants, (4) anxiolytics, (5) stimulants, (6) opioids, and (7) mood stabilizers. These particular drugs represent the largest classes of drugs studied in clinical-trials (G. Gottlieb, personal communication, August, 2011). They are some of the most popular and most commonly prescribed categories of drugs (Los Angeles County Department of Mental Health [LCDMH], 2012). Keywords remained uniform and consistent across automated searches on all four drug class categories. Authors are not extrapolating the results to all drug trials.

Since the literature shows that both the term adherence and the term compliance are used interchangeably, this study also examined the hit rates between searches involving adherence versus compliance (Tables 1-4).

Keyword searches and limiters for Pubmed

Before keyword phrases can be imputed for direct query into publications, limiters are set to narrow the search. For this study, we queried PubMed under two conditions: one in which the limiter setting on PubMed for "clinical trial" was depressed and one in which it was not. In both cases, the keyword phrases involved still included the actual words clinical drug trials. The results were not significantly different based on whether the PubMed setting of clinical trial was depressed or not, but it is probably worth noting. Additional limiters used for the PubMed searches included human subjects, all fields, last 10 years, access to full text and all publication types.

Once limiters were set, the search queries involved the following phrases:

- Clinical drug trials AND antidepressants
- Clinical drug trials AND antipsychotics
- Clinical drug trials AND anticonvulsants
- Clinical drug trials AND anxiolytics
- Clinical drug trials AND stimulants
- Clinical drug trials AND opioids
- Clinical drug trials AND mood stabilizers
- Clinical drug trials AND antidepressants AND antipsychotics
- Clinical drug trials AND antipsychotics AND anticonvulsants
- Clinical drug trials AND anxiolytics AND stimulants
- Clinical drug trials AND stimulants AND opioids
- Clinical drug trials AND antidepressants AND antipsychotics
- Clinical drug trials AND antipsychotics AND anticonvulsants
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- Clinical drug trials AND antidepressants AND antipsychotics
- Clinical drug trials AND antipsychotics AND anticonvulsants
- Clinical drug trials AND anxiolytics AND stimulants
- Clinical drug trials AND stimulants AND opioids
- Clinical drug trials AND antidepressants AND antipsychotics
- Clinical drug trials AND antipsychotics AND anticonvulsants
- Clinical drug trials AND anxiolytics AND stimulants
- Clinical drug trials AND stimulants AND opioids

The same search strings were used across all seven drug categories.
It is interesting to note that changing the order of the words in the search phrase did not change the number of articles yielded.

**Keyword searches and limiters for Science Direct**

Limiters used for the Science Direct searches included human subjects, all fields, last 10 years, access to full text and all publication types. Search phrases used paralleled the search phrases listed under the PubMed queries.

**Keyword searches and limiters for Scirus**

Limiters used for the SCIRUS searches included human subjects, all fields, last 10 years, access to full text and all publication types. Search phrases used paralleled the search phrases listed under the PubMed queries.

**Keyword searches and limiters for Scopus**

Limiters used for the SCOPUS searches included human subjects, all fields, last 10 years, access to full text and all publication types. Search phrases used paralleled the search phrases listed under the PubMed queries.

**Design**

Basic distribution of frequencies, percentages and proportions are examined. Categorical variables analyzed include the four databases searched (PubMed, Science Direct, Scirus, and Scopus), drug classes, and hit rates based on search phrase type (adherence vs. compliance). There are several levels of analyses. The first will involve a description of the observed frequencies and percentages of hit rates and a summative review of one of the populations of interest: electronic journal database. A second analysis will examine any significant differences between using the word “adherence” and using the word “compliance” in search phrases in terms of the outcome variable of proportions of articles. A third analysis will focus on identifying any statistical differences between drug classes for searches involving the word “compliance”. We chose to narrow the final search to results containing the world compliance because compliance had the larger percentage rates overall.

In summary, a review of literature published in the last 10 years was undertaken to identify:

1. The extent to which drug trial research studies considered and/or attempted to control for patient adherence to their prescribed medication regimens.
2. The difference between search phrases and results yielded based on whether the term adherence or the term compliance was used.
3. Any differences between drug classes on proportions of articles retrieved when compliance was used in search phrases.

**Materials**

Databases were accessed through the Pepperdine University remote library and electronic journal database system. Data was analyzed through IBM SPSS Advanced Statistics (version 19). The list of the specific portals for each database follows the appendices.

**Statistical Procedures**

An analysis of descriptive statistics including frequencies and proportions were conducted with SPSS (version 19). An examination of any statistical significance between hit rates based on “adherence” or “compliance” search phrases was conducted via a Chi square test of independence. Four additional Chi square tests of independence were conducted with the variables Type of Drug and Whether or Not Compliance was checked.

**Results**

**Preliminary analysis**

The preliminary analysis provides a description of population characteristics (databases searched) and percentages for hit rates based on adherence versus compliance search phrases.

Although past studies show Medline to yield higher hit rates for narrowly focused domains of research, our study showed that PubMed, which accesses Medline, yielded the lowest hit rates of clinical drug trial publications containing the words adherence or compliance when compared to the hit rates of Science Direct, Scirus, and Scopus.

The NCBI database, which houses PubMed and Medline, also covers a variety of other databases for the natural sciences such as Nucleotide, GEO profiles, Pub Chem Substance and others. The data for this analysis considered the hit rates for PubMed and Medline only. The analysis revealed that the majority of articles found under each drug class, when either the search phrase of adherence or compliance was used, neglected to control for or report attempts at measuring adherence / compliance. It is important to note that in the primary analysis of the PubMed database, the limiter setting for clinical trial was not depressed. However, in a second analysis of PubMed using the same phrases and drug classes, the clinical trial setting was used. The hit rates between the two settings did not result in marked differences of proportions yielded. To maintain conservation, an examination of the second setting in which the clinical trial box was checked showed that of the 15048 articles retrieved when the search phrase “clinical drug trials AND antidepressants” was used, only 155 (aprox 1%) of the articles mentioned adherence somewhere in the anatomy of the article. The same pattern emerged across all drug classes and regardless of whether adherence or compliance was used in the search phrase (Tables 1 through 4). The following table shows the hit rates, percentages of hit rates based on search phrase type (adherence versus compliance), and drug classes for PubMed / Medline. The results of the remaining three databases follow similar trends. Science Direct Results are found in Table 2; Scirus results in Table 3, and; Scopus results in Table 4 at the conclusion of this paper.

**Adherence vs. compliance**

Each combination of database and drug (e.g. Science Direct/ Antidepressants) was examined separately to compare searches using the word “adherence” with searches using the word “compliance” on the percentage of articles that included a check for adherence or compliance. To test whether there was a difference between the percentage (proportion) of articles checking adherence and the percentage (proportion) checking compliance, a Chi square test of independence was run for each type of drug in each database. This procedure is equivalent to comparing the percentage (proportion) for adherence to the percentage (proportion) for compliance [26]. Because of the large number of statistical tests conducted, applying Bonferroni’s adjustment procedure, an alpha level of .05/32=.0016 should be used to interpret the results.

For the Science Direct database, all tests showed a significant difference between the percentage checking adherence and the percentage checking compliance, with a higher percentage checking compliance than adherence (Table 2). For the Scirus database, the
There were significant differences between drug categories in terms of compliance. This held true for all four databases that were utilized in the study. Contained the word “compliance”, hit rates were significantly higher when queries were made to PubMed, Medline, and access through PubMed. 99% of articles lacked mention of the term “compliance”. and accessed through PubMed, 99% of articles lacked mention of the term “compliance”. Differences among types of drugs

For each database, the percentage of articles reporting that there was a check for compliance was compared across the seven types of drugs. Thus, four Chi square tests of independence were conducted with the variables Type of Drug and Whether or Not Compliance was checked. This procedure is equivalent to comparing the percentages (proportions) of articles that checked for compliance across the different types of drugs to determine whether they differ. All tests were significant at p < .001, demonstrating that the types of drugs did differ in the percentage of articles on the drug that checked for compliance.

For the Science Direct database, compliance was most often checked for Mood stabilizers (29.0%) and least often for Stimulants (18.5%; Tables 2 & 5). For the Scirus database, compliance was most often checked for Anticonvulsants (32.7%) and least often for Antidepressants (15.4%; Tables 3 & 6). For the Scopus database, compliance was most often checked for Antipsychotics (16.8%) and least often for Anticonvulsants (6.9%; Tables 4 & 7). And for the NCBI database, compliance was most often checked for Antipsychotics (3.0%) and least often for Anxiolytics (0.9%; Table 1) in the NCBI database. Compliance was most common for Antipsychotics (3.0%) and least often for Anticonvulsants (0.9%; Table 1) in the NCBI database. Compliance was found most often for Mood stabilizers (29.0%) and least often for Stimulants (18.5%; Table 2) when Science Direct was searched. Compliance was found most often for Anticonvulsants (32.7%) and least often for Antidepressants (15.4%; Table 3) in the Scirus database, and compliance was most often checked for Antipsychotics (16.8%) and least often for Anticonvulsants (6.9%; Table 4) in Scopus. This point to the lack of equivalency in publications across a variety of psychiatric drug classes. As such, all the concerns previously discussed emerge as foci for discussion.

However, cautious interpretation is advised due to the limitations of this study, which are discussed at length later. Errors in database retrieval, search phrase issues and possible problems with parameter or limiter settings should be considered. Still, the statistics overwhelmingly support the hypothesis that a low frequency of clinical drug trial articles, published in peer reviewed journals and found via popular scientific databases, actually mention adherence and/or compliance. Thus, the issues surrounding the safety and efficacy of many types of psychiatric drugs, ranging from antidepressants to stimulants, are raised.

When examining the result globally, the range of articles in which “compliance” was mentioned across all four databases and drug categories was 9% (anxiolytics in PubMed/Medline) to 32.7% (anticonvulsants in Science Direct). At the conservative end, approximately 67.3% of clinical drug trials neglect or fail to mention compliance in their publications. In a more liberal estimate, that number increases to an astonishing 99%. When search was limited to articles about anxiolytics, and accessed through PubMed, 99% of articles lacked mention of the term “compliance”.

Medication Side Effects Profiles and Patient Compliance

In examining the seven drug categories chosen for this study, one is overwhelmed by the plethora of pharmaceuticals and synthetic drugs available in each class. Each class of drugs present side effect profiles that coalesce, bleed into and overlap with the side effect profiles of others drugs. Often in clinical practice, physicians will treat patients

### Table 1: Comparison of Percentages of Articles Testing Adherence (Adher) vs. Compliance (Comp) for NCBI Database.

<table>
<thead>
<tr>
<th>NCBI Database Includes PubMed / Medline</th>
<th>Antidepressants</th>
<th>Antipsychotics</th>
<th>Anticonvulsants</th>
<th>Anxiolytics</th>
<th>Stimulants</th>
<th>Opioids</th>
<th>Mood stabilizers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Search Phrase Limiters used: human + all fields last ten years + access to full text</td>
<td>15048</td>
<td>12766</td>
<td>13923</td>
<td>10922</td>
<td>1375</td>
<td>6192</td>
<td>250 + 51 + 4</td>
</tr>
<tr>
<td>Total articles found in search (pub med section only)</td>
<td>13</td>
<td>32</td>
<td>38</td>
<td>17</td>
<td>93</td>
<td>35</td>
<td>156</td>
</tr>
<tr>
<td>Search Phrase Limiters used: human + all fields last ten years + access to full text</td>
<td>Adhr 155</td>
<td>Comp 332</td>
<td>Adhr 187</td>
<td>Comp 388</td>
<td>Adhr 51</td>
<td>Comp 171</td>
<td>Adhr 13</td>
</tr>
<tr>
<td>Adherence or compliance + Clinical drug trials + Antidepressants</td>
<td>1.0%</td>
<td>2.2%</td>
<td>1.5%</td>
<td>3.0%</td>
<td>.4%</td>
<td>1.2%</td>
<td>.1%</td>
</tr>
<tr>
<td>Adherence or compliance + Anxiolytics</td>
<td>1.5%</td>
<td>3.0%</td>
<td>1.2%</td>
<td>2.8%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adherence or compliance + Antipsychotics</td>
<td>.1%</td>
<td>.9%</td>
<td>2.5%</td>
<td>7%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adherence or compliance + Anticonvulsants</td>
<td>2.5%</td>
<td>7%</td>
<td>2.5%</td>
<td>7%</td>
<td></td>
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<tr>
<td>Adherence or compliance + Opioids</td>
<td>2.5%</td>
<td>7%</td>
<td>2.5%</td>
<td>7%</td>
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<td></td>
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<tr>
<td>Adherence or compliance + Mood stabilizers</td>
<td>2.5%</td>
<td>7%</td>
<td>2.5%</td>
<td>7%</td>
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Note: All differences were significant at p < .001, except for Stimulants, which was significant at p < .005, and Mood stabilizers, which was not significant.
with a cocktail of drugs, providing another layer of questions as to drug interaction and side effect interactions. In fact, many clinics and mental health counseling centers are turning towards evidence-based treatments, with psychotropic medications used as the frontline approach to treatment of persistent and pervasive mental illnesses (LCDMH, 2012).

A patient diagnosed with bipolar disorder may receive a cocktail consisting of an antidepressant (usually SSRI’s for BD), a mood stabilizer and in some cases, an antipsychotic. The side effects profile for antipsychotics can encompass a wide range of distressing phenomena such as extrapyramidal effects (e.g., dystonia, tardive dyskinesia, etc.), metabolic syndrome, gastrointestinal problems, hyperprolactinemia, sedation and others. To treat the side effects, a physician may then prescribe, for example when treating dystonia or dyskinesia, an anticholinergic like benzotropine mesylate or an anxiolytic (B. Moore, personal communication, March, 2012). Some of the effects of older antipsychotics include nearly permanent neurological changes. These changes include disruptions in dopaminergic and serotonergic production mechanisms that affect both the frontal and mesolimbic regions of the brain. These neuronal pathways are...
intrinsic to stable dopaminergic and serotonergic function. Brain centers like the substantia nigra that are involved in movement disorders may be impacted in long-term users of certain antidepressants creating a Parkinsonian syndrome (LACDMH, 2012). Changes to the hypothalamic pituitary axis can impact thyroid function, reproduction, and metabolism – to name a few of the long-term consequences. Certainly, it is quite understandable, at least from a humanistic paradigm, the tiring and deleterious effects of such drug regimens. In some cases, the ensuing side effects and drug interactions seem too high a cost to pay for symptom relief. Rather, it is completely understandable and perhaps expected that people would avoid such physiological changes if the theory that patients attend to a “feel good” rule ~ applies. The ultimate problem, therefore, is not in understanding why lack of and perhaps expected that people would avoid such physiological changes if the theory that patients attend to a “feel good” rule ~ applies. The ultimate problem, therefore, is not in understanding why lack of

<table>
<thead>
<tr>
<th>Scopus</th>
<th>Antidepressants</th>
<th>Antipsychotics</th>
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<th>Opioids</th>
<th>Mood stabilizers</th>
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<tr>
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<td>Adherence or compliance + Clinical drug trials + antidepressants</td>
<td>Adherence or compliance + Clinical drug trials + antipsychotics</td>
<td>Adherence or compliance + Clinical drug trials + anticonvulsants</td>
<td>Adherence or compliance + Clinical drug trials + anxiolytics</td>
<td>Adherence or compliance + Clinical drug trials + stimulants</td>
<td>Adherence or compliance + Clinical drug trials + opioids</td>
<td>Adherence or compliance + Clinical drug trials + mood Stbz</td>
</tr>
<tr>
<td>Total articles found in search</td>
<td>Adhr Comp</td>
<td>Adhr Comp</td>
<td>Adhr Comp</td>
<td>Adhr Comp</td>
<td>Adhr Comp</td>
<td>Adhr Comp</td>
<td>Adhr Comp</td>
</tr>
<tr>
<td>Percentage of total articles in this topic:</td>
<td>3821 4650</td>
<td>1599 2304</td>
<td>503 960</td>
<td>83 121</td>
<td>653 984</td>
<td>491 846</td>
<td>589 722</td>
</tr>
</tbody>
</table>

Note: All differences were significant at p < .001, except for Anxiolytics, which was significant at p < .01

Table 4: Comparison of Percentages of Articles Testing Adherence (Adhr) vs. Compliance (Comp) for Scopus Database.

<table>
<thead>
<tr>
<th>Drug</th>
<th>Compliance</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Checked</td>
<td>Not Checked</td>
</tr>
<tr>
<td>Antidepressants</td>
<td>Count 332</td>
<td>14716</td>
</tr>
<tr>
<td>% within Drug</td>
<td>2.2%</td>
<td>97.8%</td>
</tr>
<tr>
<td>Antipsychotics</td>
<td>Count 388</td>
<td>12378</td>
</tr>
<tr>
<td>% within Drug</td>
<td>3.0%</td>
<td>97.0%</td>
</tr>
<tr>
<td>Anticonvulsants</td>
<td>Count 171</td>
<td>13752</td>
</tr>
<tr>
<td>% within Drug</td>
<td>1.2%</td>
<td>98.8%</td>
</tr>
<tr>
<td>Anxiolytics</td>
<td>Count 93</td>
<td>10829</td>
</tr>
<tr>
<td>% within Drug</td>
<td>.9%</td>
<td>99.1%</td>
</tr>
<tr>
<td>Stimulants</td>
<td>Count 35</td>
<td>1340</td>
</tr>
<tr>
<td>% within Drug</td>
<td>2.5%</td>
<td>97.5%</td>
</tr>
<tr>
<td>Opioids</td>
<td>Count 156</td>
<td>6036</td>
</tr>
<tr>
<td>% within Drug</td>
<td>2.5%</td>
<td>97.5%</td>
</tr>
<tr>
<td>Mood stabilizers</td>
<td>Count 1175</td>
<td>59051</td>
</tr>
<tr>
<td>% within Drug</td>
<td>2.0%</td>
<td>98.0%</td>
</tr>
</tbody>
</table>

Drug * Compliance Crosstabulation

Table 5: NCBI Database.
adherence is so commonplace, but rather what can be done to improve medication adherence and compliance.

Measuring adherence

In the Gottlieb et al. study, authors examined several ways in which adherence is measured in both clinical and scientific settings. In the studies that addressed medication adherence, methods of assessment often lacked rigor. Common measurements for adherence include self-report, clinical judgment, pill-count data, and pharmacy records. A drawback to these methods is the indirect nature of such measurements. Ingestion of medications and adequate dosage is not easily accounted for. Scientists utilize physiological measurements such as urine toxicology screening and blood assays in more current studies (D. Turk, personal communication, March, 2011). Electronic monitoring (EM) is considered optimal in accuracy and cost efficacy [15]. EM is time stamped, which allows confirmation of when patients: opened bottles, dispensed drugs or activated a canister. Unfortunately, "…EM does not permit confirmation that the patient actually consumed medication that was removed" (D. Turk, Personal Communication, March, 2011) [1]. Positive attributes of EM include increased sensitivity to detecting drug non-adherence when compared to other methods [19,26]. EM also supplies information about medication taking patterns and patterns of non-compliant behavior (e.g., missing evening doses). According to past studies on EM, omissions of doses rather than additional or modified doses, or delays in timing of doses, modulate disruptions in medication adherence [26].

**Limitations**

There are several limitations to this study. The first is the possibility of measurement error in the automated searches. The search phrases used for this study may not have identified articles that actually controlled for adherence, using words not specified by our search queries. This is a problem in trying to be exhaustive for such large sets of studies. Search phrases or key words may not have been all inclusive and lack of sensitivity in the automated searches may be a contributing factor.

Automated searches relied on the assumption that if a researcher included a measure of adherence in their study design, there would be specific mention of adherence and/or compliance in the title, abstract, body, or methods section of the published article. It is possible that a past researcher may have included a measure of adherence or compliance in such a way that the search engine failed to identify the “adherence” or “compliance” key terms.

Another limitation is the fact that we only searched four electronic databases: PubMed / Medline, Science Direct, Scirus and Scopus. In our defense, these are very popular databases among college and post-doctoral researchers, but our results may not generalize to all electronic databases or search engines. Further, only seven drug categories were examined. Database searches of specific medications under each drug class (e.g., fluoxetine, citalopram, olanzapine, dextroamphetamine) were not conducted. However, such a search would require perspicuity and endurance in identifying and organizing brand versus generic pharmaceuticals; inspiration for another study.

A final limitation is evidenced by the fact that we only examined the findings from automated searches. Unlike the Gottlieb et al. study, which we were attempting to improve upon and replicate, a manual search was not included in the present design. This is something that should be considered in future studies that attempt to confirm present findings. These limitations, rather than being viewed as dyslogistic of our efforts, are better viewed as fuel for future research.

Readers are also reminded that the FDA and other regulatory agencies power their own private websites, some of which contain exhaustive databases. The results of this study may not generalize to all databases, and in some cases, underestimate the number of articles in which the variable of adherence was controlled and measured.

**Conclusion**

The evidence suggests that medication adherence in medical research is not a formally assessed variable; neither is it mentioned in the majority of publications available through popular electronic databases.

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### Table 7: Scirus Database.

<table>
<thead>
<tr>
<th>Drug * Compliance Crosstabulation</th>
<th>Compliance</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Checked</td>
<td>Not Checked</td>
</tr>
<tr>
<td>Antidepressants Count</td>
<td>16413</td>
<td>101115</td>
</tr>
<tr>
<td>% within Drug</td>
<td>15.4%</td>
<td>84.6%</td>
</tr>
<tr>
<td>Antipsychotics Count</td>
<td>8819</td>
<td>28277</td>
</tr>
<tr>
<td>% within Drug</td>
<td>23.8%</td>
<td>76.2%</td>
</tr>
<tr>
<td>Anticonvulsants Count</td>
<td>6564</td>
<td>13486</td>
</tr>
<tr>
<td>% within Drug</td>
<td>32.7%</td>
<td>67.3%</td>
</tr>
<tr>
<td>Anxiolytics Count</td>
<td>2817</td>
<td>6400</td>
</tr>
<tr>
<td>% within Drug</td>
<td>30.6%</td>
<td>69.4%</td>
</tr>
<tr>
<td>Stimulants Count</td>
<td>7514</td>
<td>22935</td>
</tr>
<tr>
<td>% within Drug</td>
<td>24.7%</td>
<td>75.3%</td>
</tr>
<tr>
<td>Opioids Count</td>
<td>8903</td>
<td>34551</td>
</tr>
<tr>
<td>% within Drug</td>
<td>20.5%</td>
<td>79.5%</td>
</tr>
<tr>
<td>Mood stabilizers Count</td>
<td>2786</td>
<td>6216</td>
</tr>
<tr>
<td>% within Drug</td>
<td>30.9%</td>
<td>69.1%</td>
</tr>
<tr>
<td>Total</td>
<td>55816</td>
<td>212930</td>
</tr>
<tr>
<td>% within Drug</td>
<td>20.8%</td>
<td>79.2%</td>
</tr>
</tbody>
</table>

---

### Table 8: Scopus Database.

<table>
<thead>
<tr>
<th>Drug * Compliance Crosstabulation</th>
<th>Compliance</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Checked</td>
<td>Not Checked</td>
</tr>
<tr>
<td>Antidepressants Count</td>
<td>4650</td>
<td>36009</td>
</tr>
<tr>
<td>% within Drug</td>
<td>11.4%</td>
<td>88.6%</td>
</tr>
<tr>
<td>Antipsychotics Count</td>
<td>2304</td>
<td>11424</td>
</tr>
<tr>
<td>% within Drug</td>
<td>16.8%</td>
<td>83.2%</td>
</tr>
<tr>
<td>Anticonvulsants Count</td>
<td>960</td>
<td>12966</td>
</tr>
<tr>
<td>% within Drug</td>
<td>6.9%</td>
<td>93.1%</td>
</tr>
<tr>
<td>Anxiolytics Count</td>
<td>121</td>
<td>1265</td>
</tr>
<tr>
<td>% within Drug</td>
<td>8.7%</td>
<td>91.3%</td>
</tr>
<tr>
<td>Stimulants Count</td>
<td>984</td>
<td>9063</td>
</tr>
<tr>
<td>% within Drug</td>
<td>9.8%</td>
<td>90.2%</td>
</tr>
<tr>
<td>Opioids Count</td>
<td>846</td>
<td>10429</td>
</tr>
<tr>
<td>% within Drug</td>
<td>7.5%</td>
<td>92.5%</td>
</tr>
<tr>
<td>Mood stabilizers Count</td>
<td>722</td>
<td>4149</td>
</tr>
<tr>
<td>% within Drug</td>
<td>14.8%</td>
<td>85.2%</td>
</tr>
<tr>
<td>Total</td>
<td>10587</td>
<td>85305</td>
</tr>
<tr>
<td>% within Drug</td>
<td>11.0%</td>
<td>89.0%</td>
</tr>
</tbody>
</table>
and scientific databases. The implications of such a gap in clinical trial research are disconcerting and call into question the uniformity, consistency, and safety of prescription medications. Clinical drug research may be compromised given that the precise level of drug intake during the research study period may be unknown. Conclusions about drug efficacy, safety, application and long-term effects may have questionable validity without proper assurance of adherence or compliance during the research.

This study sheds more light on a variable which has received inadequate attention in clinical drug trials, and the present findings complement and support the findings by Gottlieb and others. Two factors assure that conclusions about drug safety or efficacy are valid: 1) the medication should affect a disease or symptoms beyond what would be demonstrated by a placebo and 2) the patient must consume the medication in a prescribed dosage. Evaluations of drug efficacy and safety ride upon the assumption that all drug research adhere to strict protocols and provisions for measuring adherence or compliance. Stronger efforts to monitor medication adherence should enhance conclusions posited regarding the clinical efficacy of the drug under investigation.

List of Databases

References