

Adolescent Prescription Drug Abuse and Misuse in the United States:

A Concerning Epidemic

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Abstract

Adolescent prescription medicine misuse, particularly of controlled substances, is at all-time highs in the United States. While illicit street drugs, tobacco use, and underage drinking are all on the decline among teenagers, prescription medicines have now equaled marijuana as the most commonly abused drugs reported by America's youth. The epidemic cuts across all socioeconomic classes and is based in myths and misinformation that pervade the American culture. Current modalities to address the problem concentrate solely on the policy aspects. More research into the most effective modalities to affect healthy adolescent behavior is needed, though science-based education has shown early promise.

"We're living in a time that seems decidedly more apocalyptic, especially since 9/11 and the recent natural disasters. Maybe we need something to slow down."-- John, High School Senior from Austin, TX. (Friedman, 2006)

Scope

Prescription drug use and abuse is on the rise throughout our country. The last two decades have witnessed dramatic increases in the use of all prescription medicines, but prescription pain relievers (PPRs) have seen the highest rates of use. From 1992 to 2002, prescriptions for the most popular PPRs, hydrocodone and oxycodone, rose 376% and 380%, respectively. This in contrast to prescriptions for all other medications, which only increased 61% while the U.S. population grew by only 12% (Sung, Richter, Vaughan, Johnson, & Thom, 2005).

Most disturbing, however, about this trend is the increased use and misuse of prescription medications by adolescents. In 2007, adolescents aged 12-17 accounted for 37% of all new nonprescribed PPR users (Wu, Ringwalt, Mannelli, & Patkar, 2008). This trend is reflected in the 163% increase in high school senior emergency department visits for opiate abuse between 1995 and 2002 (S. E. McCabe, Boyd, & Teter, 2005). Unfortunately, PPRs are not the only prescription drugs being abused by our country's youth. Stimulant and sedative use is on the rise as well, though stimulants are becoming less popular. According to the Monitoring the Future study, drugs inciting euphoria or calming effects are now the drugs of choice among adolescents (Friedman, 2006).

Moreover, alcohol and cigarette smoking are at all time lows, and illicit drug use in the form of cocaine and heroin is on the decline (Friedman, 2006). In fact, only marijuana rivals prescription drugs in prevalence of abuse. In 2007, the number of new users of prescription drugs equaled that of new users of marijuana among 12-17 year-olds. This same age group was second only to those aged 18-25—an age still crucial to brain development-- in rates of prescription drug abuse. Perhaps most alarming, the age of onset of prescription drug abuse is dropping drastically. As of 2006, prescription drugs became the most abused substances among youths aged 12-13 (Office of National Drug Control Policy, 2007).

Clearly, prescription drug abuse has become a major problem for the youth of America. The phenomenon has even invoked its own slang, “pharming,” or the nonmedical use of prescription medicines (Levine, 2007). It is highly associated with polysubstance abuse, psychiatric disorders, and often creates lifelong patterns of continued abuse and maladaptive health behaviors.

This paper will attempt to identify those adolescents most at risk for prescription drug abuse and explore the reasons young people turn to prescription medicines. It will also emphasize the impact of adolescent prescription abuse on the public health system, review important neurophysiology that make the teenage brain more vulnerable and susceptible to substance abuse, and critique deterrent policy measures currently in place. Lastly, a platform for evidence-based suggestions concerning new and existing methods of prevention will be postulated.

Terminology

Before continuing, clarification of certain terms must be addressed to accurately define the issue. The following definitions, unless otherwise noted, are adopted from Stedman's Medical Dictionary, a widely accepted publication in the medical community (American Medical Association, 1997).

Opioids. A narcotic substance, either natural or synthetic. For the scope of this paper, this will refer to naturally occurring substances produced by the human body.

Opiates. Any preparation or derivative of opium.

Drug Abuse. Habitual use of drugs not needed for therapeutic purposes, such as solely to alter one's mood, affect, or state of consciousness, or to affect a body function unnecessarily.

Prescription Drug Misuse. The nonmedical use of a prescription drug without a doctor's prescription, encompassing both self-medication (intended benefit) and recreational use (to get high) (Twombly & Holtz, 2008).

Demographic Trends

If progress is to be made in addressing this crisis, resources must be directed toward those at the highest risk of abuse. Multiple reviews have now identified demographic trends among youth who abuse prescription drugs.

Age. Adolescent nonmedical PPR use begins at a mean age of 13.3, comparable to that of alcohol (13.1) and marijuana (13.6) (Wu, Ringwalt et al., 2008). Rates increase as teens age, with 5% of 12-13 year-olds reporting misuse compared to 16% of adolescents aged 16-17 (Wu, Pilowsky, & Patkar, 2008). The

age of onset for both sedatives and amphetamines is thought to be similar, though there is conflicting data as these drugs are more often prescribed to younger patients for medically relevant conditions.

Sex. Females are slightly more likely to misuse prescription drugs across all classes (Twombly & Holtz, 2008). However, among high school seniors, males' abuse of PPRs tends to equal or surpass that of their female counterparts (S. E. McCabe et al., 2005).

Race. Non-Hispanic whites have the highest rates of PPR and sedative abuse among the major races in the U.S. They are 1.17 times more likely than Blacks and 1.11 times more likely than Hispanics to misuse. The outlier is American Indian with a rate of 14.3% compared with the white rate of 10.5% (Wu et al., 2008).

Income. A family income of \$0-\$19,999 is associated with higher rates of prescription drug abuse across all classes, reporting between 11.1%-11.5% (Sung, H.E. 2005 (Wu et al., 2008)).

Geographic Location. Adolescents aged 12-17 in Southeastern and Western states are more likely to abuse any prescription drug (Office of National Drug Control Policy, 2007). Rural areas experience higher misuse rates compared to metropolitan areas (11% vs. 8.6%) (Wu et al., 2008).

Positive correlations also exist in those with academic problems, those with personal behavior problems, and those who abuse other substances. In particular, polydrug use with alcohol, benzodiazepines, and other opiates were prevalent in emergency department visits. (S. E. McCabe et al., 2005).

Public Health Implications

Prescription drug abuse among adolescents has far-reaching implications for the future of public health in the United States. Direct correlates between early initiation of substance abuse and multiple habits harmful to health have been described by numerous authors (S. E. McCabe et al., 2005; S. E. McCabe, Teter, Boyd, Knight, & Wechsler, 2005; Nasrallah, Yang, & Bernstein, 2009; Substance Abuse and Mental Health Services Administration, Office of Applied Studies., 2008; Wu et al., 2009). There have also been significant pressures on an already beleaguered health system imposed by the abuse of these substances.

Opiates. According to McCabe et al, adolescent use of the PPRs Vicodin and OxyContin were more significantly more likely to abuse alcohol, misuse other prescription and illicit drugs, and experience academic and behavior problems (S. E. McCabe et al., 2005). Most concerning in this paradigm is the cumulative effect of polysubstance abuse. Excessive alcohol use during adolescence has been demonstrated to lead to suboptimal decision making long after discontinuation (Nasrallah et al., 2009), and adolescent exposure to cannabinoids alters “the responsiveness of selected brain areas to different internal and external stimuli” (Realini, Rubino, & Parolaro, 2009). Thus, the possible fallout from comorbid substance abuse made more likely by PPR abuse early in life is threatening to one of public health profession’s primary goals—education leading to healthy behaviors.

Adolescent PPR abuse and addiction have also been responsible for unprecedented rises in emergency department (ED) visits and admissions to treatment centers. ED’s reported a 21% increase in visits involving abuse of PPRs

from 2004-05, and drug treatment centers witnessed over a 300% increase from 1996-2006 (Office of National Drug Control Policy, 2007).

Stimulants. Opiate abusers share their polysubstance characteristic with those who misuse stimulants. According to a breakout analysis from the 2005-06 National Survey on Drug Use and Health (NSDUH), youths aged 12-17 who participated in the nonmedical use of stimulants engaged in higher rates of illicit and other prescription drug use (Substance Abuse and Mental Health Services Administration, Office of Applied Studies., 2008). A second survey confirmed this same finding carrying over into college as nonmedical users of prescription stimulants were over four times as likely to experience high scores on the Drug Abuse Screening Test-10, a common screening tool for substance abuse, than nonusers (S. E. McCabe & Teter, 2007).

Also concerning in the NSDUH report was that adolescent nonmedical stimulant users were over two times as likely to have engaged in any of six different types of delinquent behavior over the previous year, including getting into fights, carrying handguns, selling illegal drugs, stealing, or attacking another with the intent to harm.

Lastly, 22.8 % of these youths experienced a major depressive episode over the previous year, compared to only 8.1% of their counterparts (Substance Abuse and Mental Health Services Administration, Office of Applied Studies., 2008).

The nonmedical misuse of both PPRs and prescription stimulants are placing considerable strain on our healthcare system and contributing to lifelong detrimental behaviors that will plaque our future generations. If measures to

reduce healthcare spending and curb the secondary effects of maladaptive behavior gleaned early in childhood are to succeed, it is imperative that the early misuse of prescription medicines is addressed.

Adolescent Neurophysiology and Neuropharmacology

Much work has been done to better understand the changes that occur in the adolescent mind during its development. Studies regarding the neurocircuitry of mammalian adolescents have demonstrated that during this highly formidable time, “hormonal changes, behavioral characteristics and brain transformations, including alterations in reward-wired circuitry,” the brain is highly susceptible to small changes in neurotransmitter concentrations (Doremus-Fitzwater, Varlinskaya, & Spear, 2009).

Interestingly, the most prevalent theory for this phenomenon is based in evolution. According to Spear, the behaviors most often noted across species during adolescence include increasing risk-taking and interactions with peers as well as enhanced sensation and novelty seeking. Applied in a survival setting, these traits serve a species well to promote the search for new territories and sources of food. They also encourage variability in the genetic pool through interaction with different sexual partners (Spear, 2007a). However, these same techniques, when applied in a modern day setting, are more often motivators to seek out new forms of chemical alteration in the adolescent brain.

Dopamine (DA), the neurotransmitter most responsible for the sensation of euphoria, is the main chemical altered by both opiates and stimulants (Wise &

Bozarth, 1985). DA is most active in the nucleus accumbens, where the euphoric sensation originates. Repetitive dopaminergic stimulation in the nucleus accumbens drives the brain to more aggressively seek out hedonistic activities. Moreover, because the connections among these reward-relevant regions appear to be enhanced during adolescence, the neurocircuitry is highly susceptible to alteration, developing more DA receptors in these areas (Doremus-Fitzwater et al., 2009). While theories for pleasure-seeking behavior vary greatly from that of a perceived hypo-DA state to an increased sensitivity toward DA, there is no doubt that DA receptors (D1-Rs) are more numerous in late adolescence (40%) than in either younger or older ages (<4-5%) (Doremus-Fitzwater et al., 2009).

It makes sense, then, that the flooding of these receptors would serve as a stimulus to the developing brain, inciting it to retain a high concentration of D1-Rs. Each time an adolescent activates this reward system with drugs, “the odds go up that the individual will repeat this activity in the future” (White, 2009). This is why substance abuse is more likely to begin in adolescence than at any other time. It is a classic example of supply and demand: the demand has been established, and simply imbibing in the appropriate substance provides a supply.

Proposed Reasons for the Rise in Abuse and Misuse

So, what is responsible for this growing confidence in prescription drugs? While many postulates have been offered for adolescent misuse of prescription medications among America’s youth, the common denominator is the misperception of the safety of these drugs. Forty percent of teens report that prescription drugs

are safer to use than illegal drugs, and “one-third believe there’s ‘nothing wrong’ with using prescription medicines without a prescription once in a while” (Office of National Drug Control Policy, 2007).

Also clear is that the motive for abusing prescription drugs is different than that of illicit drugs. Forty-five percent of past-year teen users of PPRs report using them “to relieve physical pain” (S. E. McCabe, Boyd, Cranford, & Teter, 2009). In Friedman’s interviews, he found that teens more often use all classes of controlled substances for their intended purposes: hypnotics for sleep improvement, stimulants to enhance performance, and tranquilizers to relieve stress (Friedman, 2006).

To gain a better understanding of where these habits originate, one must delve into the frameworks long used to understand health behavior.

The Health Belief Model. First described by Rosenstock in 1966, the Health Belief Model (HBM) maintains that the perceived susceptibility, severity, barriers, and benefits of an action most aptly determine an individual’s decisions with regard to his health (Rosenstock, 1974). These indicators have since been deconstructed into the following mediating factors: demographic variables, socio-psychological variables, perceived efficacy, cues to action, health motivation, perceived control, and perceived threat (Becker, 1976). Because these determinants are subjective (i.e., perceived), the end product results largely from an internal processing of external influences, especially in the highly impressionable state of adolescence. Moreover, early deviation from behaviors deemed healthy often leads to continued detrimental habits due to the overemphasis of the reward system in the adolescent

brain. To better conceptualize the influences that sway adolescents and pervade our culture, another model is useful to examine.

The Social Ecological Model. The Social Ecological Model (SEM) is a framework used in public health to connect an individual to his environment. The SEM most often used for public health purposes is Bronfenbrenner's, in which five strata are described: individual, interpersonal, community, organizational, and public policy (Wikipedia, 2009). The interactions among these components of the SEM are further described as micro-, meso-, and macrosystem relationships, but for the scope of this paper, the terms proximal and distal will be used to describe the influences paramount to the development of an adolescent's HBM.

Proximal Influences. These influences are believed to most directly affect development in an adolescent's world, and encompass both the micro- and mesosystem. The microsystem is "the internal state of the child and his or her close family and peers," while the mesosystem encompasses the connections between the components of the microsystem (i.e., conversations with parents and peers) (Twombly & Holtz, 2008).

The most significant proximal influence in a teenager's life is the influence he receives from his parents and relatives. Whether or not an adolescent is genetically inclined to have abusive patterns, "indirectly, through exposure to models of drug use behavior" in the home, patterns may develop (Compton & Volkow, 2006). Children who are taught in the home about the risks associated with drug use are 50% less likely to abuse, though parents are much less likely to discuss prescription drug misuse than illicit drug abuse. In fact, up to 60% of parents report discussing

drugs like marijuana “a lot,” just one-third discuss the risks associated with prescription drugs (Partnership Attitude Tracking Study, 2006).

Not only does verbal communication have much to do with prescription drug abuse, but nonverbal cues-- such as frequent use of prescription medications by relatives-- sends the message that they are less dangerous (Compton & Volkow, 2006). Medicine sharing among relatives may be the most detrimental of modeled behaviors in the home, especially since half of teens report the source of their prescription medicines from a relative or friend (Office of National Drug Control Policy, 2007). Often parents are not even cognizant of these cues since they themselves do not fully understand the risks associated with prescription medicines.

It is therefore a pattern that propagates itself from generation to generation. Instead of using healthy means to relieve stress or achy muscles, American culture has turned to pharmacotherapy to remedy ailments common to the human condition. “Do we really want teenagers to think nothing of popping a pill to relax, get through the tedium of a long homework assignment, or relieve normal anxieties,” asks Friedman (Friedman, 2006). Unfortunately, in the U.S., it seems the answer has become “yes.”

Distal Influences. School, community, organizations, and media all compose distal influences, as well as the culture and history of an environment. They tend to be somewhat less tangible and subtle than proximal influences, and their often-unidirectional nature does not allow adolescents to interact with their messages (Twombly & Holtz, 2008).

Most prominent among these pressures is media. While effective media campaigns have cast a negative light on street drugs, the pharmaceutical agency has bombarded all sources of print, television, and the Internet with advertisements for prescription medications, fostering a belief that prescription drugs are a part of everyday life for most Americans. Direct-to-consumer advertising (DTCA) expenditures rose from \$1.8 billion in 1999 to \$4.7 billion in 2007 (Friedman, 2006; Twombly & Holtz, 2008). In addition, adverse side effects have been reduced to “the fine print of an advertisement or dispatched in a few seconds of rapid-fire speech” (Friedman, 2006).

Internet advertising and sales is perhaps the most worrisome trend. Though it constitutes a smaller market than television and print, as of 2006, \$163 million was spent on Internet advertising, and 581 sites in total advertise and sell prescription drugs. Moreover, 84% of these do not require a doctor’s prescription (Twombly & Holtz, 2008). The most popular drugs on these sites were the anxiolytics Xanax and Valium, followed by the pain relievers OxyContin and Vicodin (Twombly & Holtz, 2008). Not one of the sites had any way to block children from accessing their products (Compton & Volkow, 2006).

Physicians play a large role as well. According to Sung, two events over the last twenty years have had a significant impact in the PPR market—the establishment of pain management as a recognized specialty in the late 1980s and the launch of new formulations of pain medicines in the early 1990s (Sung et al., 2005). The resulting 300-400% increase in prescriptions for the PPRs hydrocodone and oxycodone from 1992-2002 illustrates well the upsurge in supply and demand,

providing medicines to be used and diverted (Twombly & Holtz, 2008). Two reasons are primarily responsible for this trend. On the provider's behalf, a lack of awareness or relaxed attitude toward controlled substances has prevailed, while at the same time patients have developed the expectation for a pharmacotherapeutic answer to all ailments.

A 2004 survey found that 43% of physicians do not appropriately screen patients for a history of prescription drug abuse, and one-third did not obtain prior records (Friedman, 2006). An 18-year-old interviewed, reported, "You can always find a doctor who you can convince that you have a sleeping problem to get Ambien or that you have ADD and get Adderall" (Friedman, 2006). Decreasing reimbursement in a capitalistic medical system causes strain on providers, who often feel pressured to see more patients. In this setting, it is much easier to give into the therapeutic expectation of the patient rather than spend time counseling on alternative effective therapies.

The prescription has come to "symbolize both the physician's acknowledgement of the patient's suffering and the patient's hope for relief" (Lurie & Lee, 1991). The objective evaluation and potential counseling of the provider has become less important as the patient-doctor relationship has devolved into the most "material embodiment" of the encounter—the prescription (Lurie & Lee, 1991). When one of the two active participants carries this expectation into the encounter, a healthy outcome may occur, but when both parties bring this belief into the room, the prescription will prevail.

Policy

Current Policy. For now, the majority of policy measures concentrate distal influences by creating controls to monitor the distribution of controlled substances. Many states intermittently review the prescribing patterns of providers, taking issue with those they find alarming. Federally, those providers with inappropriate prescribing practices are subject to being censured in the National Practitioner Data Bank (Clark, 1991).

This approach has two main flaws when applied to the general public, and two more arise when applied specifically to adolescent prescription drug misuse.

First, it addresses only the source of the prescription-- the provider. State procedures regarding drug control vary greatly, but in most states, it focuses primarily on the quantity of medicine a provider distributes without significant chart review. It is a fear-invoking system for providers, hampering their effectiveness in treating patients who have significant pain. The Conquering Pain Act of 2003 (CPA) sought to address these issues, but fell short when it failed to require the Drug Enforcement Agency and states to follow specific guidelines when faulty prescribing habits are suspected (Dilcher, 2004). Compliance with such guidelines would provide a clear algorithm for providers to follow when treating pain.

Secondly, because most monitoring boards are state-based, they have limited access to patients with private insurance. Insurance companies are as successful as they are because they look for states with low medical costs in which to provide

services. Therefore, many patients have employer-based insurance that is out-of-state and largely unavailable to review boards due to HIPAA regulations.

Thirdly, because only 21% of teens report one or more providers as the source of their prescription medicine, many cases go undetected (Office of National Drug Control Policy, 2007). Adolescents in large part receive medicines from a friend or relative, or buy them from a dealer or online.

Lastly, the very basis of this system—concentrating only on distal policy influences—omits the proximal influences such as parents and schools, which have a greater effect in the life of an adolescent. Indeed, since the “War on Drugs” of the 1980’s, school-based prevention programs have greatly declined, largely in lieu of policies such as No Child Left Behind (Twombly & Holtz, 2008). When schools do implement anti-abuse programs, they are often outdated and concentrate solely on illicit substances, not the growing threat of prescription medication abuse.

Recommendations for Prevention

If the growing trend among teenagers to misuse prescription medicines is to be reversed, it must be confronted within a concise, succinct framework. The SEM provides just such a framework to address the influences across the spectrum, from proximal to distal.

Proximal

School-Based Prevention Programs. Unfortunately, recent policy changes passed by the Bush administration have handicapped effective, science-based education

programs about the dangers of drugs, opting instead for more rigorous educational programs suited to the passing of standardized tests.

A return to science-based education about the dangers of drugs, including prescription medications, would clearly have a positive impact. As demonstrated by Fishbein and Middlestadt, the incorporation of accurate knowledge and subsequent development of protective behaviors is essential to substance abuse prevention (Fishbein, M. and Middlestadt, S.E., 1987). Science education has been demonstrated to positively impact the knowledge and attitudes of students on drugs of abuse (Holtz & Twombly, 2007). This type of learning has two distinct advantages over traditional prevention programs: it is not vague in its descriptors, and it contains no overt messages against abuse (Twombly & Holtz, 2008). Adolescents tend to respond better to messages presented when they feel they are being treated as adults. Presented in an age-appropriate format, these messages should emphasize the neuropharmacology of prescription medications, specifically how they change the functioning of the brain and may lead to permanent changes in neurophysiology.

Second, school-based programs should also provide outreach to parents. This approach would most adequately address the supply side of the problem as most teens report relatives as the source of their prescription medicines. Ideally, such programs would provide parents with “concrete strategies and information” which would be reinforced in the home through open conversation and awareness of potentially detrimental modeling behaviors (Twombly & Holtz, 2008).

Third, incorporation of a media-filtering component would be beneficial, allowing students and parents to better decipher messages presented in this unidirectional modality of communication (Twombly & Holtz, 2008). Living in a media-saturated culture, this element would be a useful tool for adolescents.

Screening through School Counselors. Parents, school personnel, and educators should all be on alert to the possibility of PPR use and abuse among high school students. However, like adults in the workplace, at least one-third of an adolescent's time is spent at school. The role of the school counselor, reduced in recent years to that of a career planner, provides a unique opportunity to identify potential psychiatric problems or aberrant behavior possibly associated with drug misuse. Requiring specialized training in this area for school counselors, regular review of school records, and mandatory counseling "check-ins" for students should be part of all public school systems. This type of system would potentially identify any harbingers of discontent in the all-important internal state of adolescents.

Distal

Limiting Direct-to-Consumer Advertising. The average American now sees as much as sixteen hours of prescription drug advertising on television per year (Frosch, Krueger, Hornik, Cronholm, & Barg, 2007). Coupled with the expanding Internet market, America's youth are being pummeled with advertising, fostering an image of prescription drugs as "an integral and routine aspect of everyday life" (Friedman, 2006).

For a program to be successful, the Food and Drug Administration (FDA) must begin enforcing stricter policy on pharmaceutical companies. Since the FDA

relaxed restraints on against DTCA in 1997, pharmaceutical advertising has dominated mainstream media. The link between advertising messages and the misuse of prescription drugs has been linked anecdotally in recent years for two reasons: the messages reinforce the safety of drugs prescribed by physicians, and media portrayals of those on prescription drugs make them seem “ubiquitous and routine” (Twombly & Holtz, 2008). DTCA and its effect on teen prescription misuse is an area that deserves more research as the link to this point is only anecdotal.

A sensible alternative would be restricting pharmaceutical advertising to medical journals, allowing educated providers to decipher the messages themselves, hopefully decreasing the influence of such messages in the doctor-patient encounter. A more extreme option would be taking the patent ability away from pharmaceutical companies, though this option would face much scrutiny in America’s privatized medical system, not to mention objection from the enormous lobbying force that the pharmaceutical industry has established in Washington DC. The “generification” of all medicines has been successful in countries such as Canada, Germany, and Great Britain. It would solve the DTCA quandary, though it will likely only occur with a complete overhaul of the American health system.

Improving Provider Awareness and Education. Providers must begin to play a more active role in their patients’ attitudes toward prescription drugs. They should spend more time counseling patients for whom they prescribe opiates of the dangers associated with such drugs. Screening adolescents for potentially addictive behaviors can be accomplished through brief questionnaires for both the teen and parent. “The 6G’s” is one such method described by Heyman (Heyman, 2009). It

incorporates questions regarding genetics, peer groups, perceived availability of drugs, the temptation to seek drugs, the dangers of drugs, both physiologically and legally, and attitudes on guidance should it be necessary.

Additionally, efforts must be made to better educate providers. This suggestion involves two main components. First, more emphasis should be placed on pharmaceuticals in medical schools. Though pharmacology is a substantial part of the preclinical years of medical schools, not enough emphasis is placed on it during the practical latter half of medical school or into residency, when the physician develops his repertoire during patient interaction (Lurie & Lee, 1991). In one survey of physicians, up to one-third did not feel “confident” about their education regarding controlled substances (Lurie & Lee, 1991). More continuing medical education, a required aspect for the practicing provider to remain licensed, should be directed toward controlled substances.

Second, there should be less interaction between providers and detailers (Lurie & Lee, 1991). As of 2006, 90% of the \$21 billion annual budget of the pharmaceutical industry concentrated on physician advertising, the majority of which was devoted to the salaries of sales representatives or journal advertising (Brennan et al., 2006). The money is apparently well spent as up to 63% of providers report the detailers have a significant impact on their prescribing habits (Brennan et al., 2006). Though this author did not find specific numbers for PPRs or anxiolytics, with this market expanding exponentially, the pharmaceutical companies are sure to shift even more resources toward these classes. One solution for this phenomenon “counterdetailing,” that is the involvement of well-trained

physicians or pharmacists who do not advocate a specific brand name (Lurie & Lee, 1991). Visits to physician offices by such personnel should be the alternative to the smooth talking representative that has come to represent the sales market.

Limiting Prescribing Authority. Unpopular with most providers, this alternative would take authority from midlevel providers and limit the prescribing privileges of physicians without specialty training to prescribe certain medicines (Lurie & Lee, 1991). Like many strategies, it applies not only to adolescents, but also to the larger population of patients who use prescription medicines. With only 2% of graduates going into the primary care specialties, where most adolescents who misuse medicines receive them legitimately, the midlevel provider is becoming the cornerstone of many primary care specialties (Chen, 2009). A reasonable compromise would at least include restricting the prescribing abilities of midlevels.

Alternative Formulations for PPRs. Probably more resources have found their way into this avenue for limiting abuse than any other, due mostly to pressure from the government on pharmaceutical companies. By altering the composition of potentially abusive medicines, specifically PPRs, with drugs such as naloxone, the euphoric feeling addicts are looking for is negated. This solution does have promise, but it seems humans have a unique ability to discover new ways in which to get high daily.

More promising for deterring adolescent drug abuse are new formulations that do not allow medicines to be crushed, smoked, or snorted to achieve a more intense high. According to McCabe, intranasal use of PPRs is common among teens, and intranasal abuse of stimulants is almost as common as oral administration

among college students (S. E. McCabe, Cranford, Boyd, & Teter, 2007; S. E. McCabe & Teter, 2007).

Also promising is the development of drugs that do not act centrally on the brain, but more peripherally. The medicines gabapentin and pregabalin are two such drugs commonly prescribed for neuropathic pain. Of greater interest is the developing field of medicines that bind to cannabinoid receptors peripherally (Compton & Volkow, 2006).

Electronic Prescription Monitoring. Lastly, electronic prescription monitoring systems offer ways to limit abuse. First explored in the 1980s to replace the multiple copy, or “triplicate,” programs, these systems are now becoming more commonplace in states (Brushwood, 2003). They allow for communication among pharmacies and between pharmacies and providers. The National All Schedules Prescription Electronic Reporting (NASPER) program came to fruition in August of 2005, and at last count, thirty-seven states were actively participating (National Society of Interventional Pain Specialists, 2009). This federal database allows prescriptions to be tracked across state lines. While this program and state programs like it do not apply specifically to adolescents, they do make significant progress toward reducing the number of potentially abusive prescription medicines available.

In sum, while multiple programs described above deal with the distal aspects of the SEM and may be effective, more work must be done to address the more proximal factors, as these have been demonstrated to be more influential in an adolescent’s life. Those who are educated about the dangers of drug abuse from

their parents are half as likely to use drugs (Friedman, 2006). In addition to emphasizing education in the home, the reintroduction of science-based education could potentially have more impact than any intervention to date.

Conclusion

Adolescent prescription drug abuse and misuse has become a crisis in the United States. The harrowing trend of our country's youth toward harmful prescription medicines is not only a public health problem, but it also signifies a deeper, culturally rooted calamity that we are facing. Choosing to turn away from healthy lifestyle decisions in lieu of a chemical cure has become a way of life, depicted in the media and emulated in the home.

Because brain development continues into the early twenties, we must consider the long-term effects we are having on these developing minds. Neuropathways are highly influenced by controlled substances, and exposure to these medicines during the adolescent stage of life can form reward pathways that are permanent. It is a recipe for disaster.

Addressing current policy is implicit in remedying this dilemma, but more important is confronting the predicament on the intra- and interpersonal levels of the social ecologic model through science-based education and school-based programs. As is the case with all public health problems, education is vital if we are to see real change.

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