Cannabis Experts Take Center Stage: From the Margins to the Mainstream

PROCEEDINGS OF THE 1ST ANNUAL CONFERENCE OF THE INSTITUTE OF CANNABIS RESEARCH AT CSU-PUEBLO

April 27-29, 2017

Institute of Cannabis Research
CONFERENCE 2017

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Conference Materials

Presentation slides, posters, and recorded presentations are available in the CSU-Pueblo Digital Repository: https://dspace.library.colostate.edu/handle/10217/179624

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Introduction

Tim McGettigan, Conference Committee Chair
Colorado State University-Pueblo

Amendment 64 ended nearly a century of cannabis prohibition in Colorado. Being among the first states to legalize recreational and medical cannabis, Colorado faced a steep learning curve. In addition to unknowns in the areas of taxing, regulation and commerce, Coloradans simply had no idea what sort of impact legal cannabis would have on day-to-day life in Colorado.

Acknowledging that there were more unknowns than the Legislature could possibly answer on its own, the Colorado Assembly delegated the responsibility of researching the myriad dimensions of legal cannabis to state university experts. On June 6, 2016, Governor John Hickenlooper signed Senate Bill 191 into law. SB 191 called for the creation of an Institute of Cannabis Research (ICR) at Colorado State University-Pueblo. The ICR at CSU-Pueblo is unique among cannabis research institutes due to the breadth of its research mission. Many cannabis research centers focus on a narrow range of biomedical issues. However, the ICR aspires to study "all things cannabis." This means that, in addition to biomedical research, the ICR also supports research in disciplines that range from art to zoology.

Since no single university could possibly explore "all things cannabis" on its own, from the outset the ICR has been committed to outreach, partnerships and collaboration. As a means of building networks and sharing knowledge, the ICR decided to host an annual conference. The goal of the ICR Conference is to attract the widest variety of cannabis researchers from as many corners of the globe as possible.

The inaugural ICR Conference in 2017 attracted over 500 attendees and researchers from every field of cannabis expertise. Some of the most accomplished cannabis researchers in the world—including Raphael Mechoulam, Carl Hart and Alexandros Makriyannis—attended ICR 2017 and delivered horizon-expanding addresses.

Successful as the ICR's inaugural year was, we look forward to even greater accomplishments in 2018. For much of the past year, the ICR Publications Committee has been working with Springer to launch a brand new academic journal, the *Journal of Cannabis Research*. In addition, the ICR at CSU-Pueblo is planning to hold its second annual conference from April 26-28, 2018. Audra Stinchcomb, former CSU-Pueblo student and current Professor of Pharmaceutical Sciences at the University of Maryland School of Pharmacy, will deliver ICR 2018's opening plenary address about her research in the area of transdermal medicine delivery. The ICR is also proud to announce that Vincenzo Di Marzo, Research Director at the Institute of Biomolecular Chemistry of the National Research Counil in Pozzuoli, Naples, Italy, has agreed to deliver the Second Annual Mechoulam Lecture.

All of the faculty, administrators, students, staff and researchers who are associated with the ICR at CSU-Pueblo sincerely hope that you will find much of interest in the Proceedings of the ICR 2017 Conference. We also hope that you will consider attending the ICR 2018 Conference and "exploring all things cannabis" with the most eclectic assemblage of cannabis researchers in the world.

About the ICR

Mission

The Institute of Cannabis Research generates new knowledge of cannabis and its derivatives through research and education that improves lives and contributes to science, medicine, and society.

History

The Institute of Cannabis Research (ICR) was established in June 2016 through an innovative partnership between Colorado State University-Pueblo, the state of Colorado, and Pueblo County. With $270,000 in Pueblo County funding and $900,000 in initial state funding, the ICR became the nation's first multidisciplinary cannabis research institute at a regional, comprehensive university. A steering committee comprised of university leaders was created in June 2016 under the oversight of the university provost. Three working groups were established, each responsible for one of the ICR's designated goals.

The ICR was charged with three major goals in its first year of funding: 1) to conduct pure and applied research across multiple disciplines with CSU-Pueblo faculty and students; 2) to host the first international multidisciplinary scientific research conference on cannabis; and 3) to publish conference proceedings and launch a multidisciplinary research journal.

Currently, ten research studies are in progress involving 22 CSU-Pueblo co-investigators and numerous other faculty, undergraduate, and graduate students. The first conference was held April 28–30, 2017. Renowned cannabis scientists Dr. Raphael Mechoulam and Dr. Alexandros Makriyannis served as keynote and plenary speakers. Almost 600 researchers, scholars, and industry experts were in attendance, representing 19 states and six countries.

The *Journal of Cannabis Research* launch is planned for early 2018. The ICR was appropriated $1.8 million in funding from the state of Colorado for 2017–2018 to continue its mission. The ICR's focus is to develop a quality research and programming infrastructure as it strives for local, state, national, and international impact.

Keynote & Plenaries

Opening Plenary

How and Why Cannabis Research is Biased Toward Negative Effect

Carl Hart, Columbia University

Presentation videorecording: http://hdl.handle.net/10217/181088

Keynote Address: Inaugural Mechoulam Lecture

The Endocannabinioid System: A Look Back and Ahead

Raphael Mechoulam, Hebrew University

Presentation videorecording and slides: http://hdl.handle.net/10217/181090

Over the last few decades research on the cannabinoids has gone through several distinct phases: 1) research on the plant cannabinoids, mostly on tetrahydrocannabinol (THC) and cannabidiol (CBD); 2) research on the endogenous cannabinoids, mostly on anandamide and 2-arachidonoyl glycerol (2-AG); and 3) research on anandamide-like endogenous fatty acid amides with amino acids and ethanol amines.

Thousands of publications have been published on the plant cannabinoids and some of them are already in use as therapeutic drugs. Of particular interest is CBD, which does not cause the typical cannabis psychoactivity, but is an anti-epileptic drug and is being evaluated in other therapeutic areas (for example, schizophrenia and auto-immune diseases). Anandamide and 2-arachidonoyl glycerol (2-AG) are involved in a very large number of human diseases, mostly as neuroprotective entities. Endogenous fatty acid amides have been shown to be of major importance in a large spectrum of biological functions and diseases. Thus, oleoyl serine is an anti-osteoporotic molecule and arachidonoyl serine is a vasodilator and lowers brain damage. We can expect therapeutic advances in all three areas.

Closing Plenary

The Endocannabinioid System: A Source for Drug Discovery

Alexandros Makriyannis, Northeastern University

Presentation videorecording and slides: http://hdl.handle.net/10217/181089

Cannabis has been used over the millennia for therapeutic purposes. It has also been used as the basis for discovering a key biochemical lipid network, the endocannabinoid system. Among the lipid modulators, endocannabinoids play a key role. Our current knowledge of the endocannabinoid system includes CB1 and CB2, two Gi/o GPCRs involved in a number of signaling mechanisms. The endogenous molecules that modulate this biochemical system, which include ethanolamides as well as 2-glycerol esters of long fatty acids are represented by arachidonoylethanolamine (anandamide) and 2-arachidonoylglycerol (2-AG). The levels of these endocannabinoids are modulated by a number of membrane associated enzymes, including the amidase, fatty acid amide hydrolase

(FAAH) and the esterase, monoacylglycerol lipase (MGL), as well as by a transporter system that remains to be fully characterized. Regulation of the levels of endocannabinoids and related lipids in different organs can provide significant nutritional or therapeutic opportunities. Modulation of the endocannabinoid system either directly (through CB1/CB2) or indirectly (through enzymatic or transport inhibition) provides opportunities for the design and development of small ligands capable of effecting physiological changes and, thus, serve as potential drug candidates. This target-based drug design utilizes a combination of computational and biophysical methods. The biochemistry of the endocannabinoid system and approaches involving its modulation for nutritional or therapeutic opportunities are discussed. Research supported by grants from NIH: DA009158, DA003801, and DA023142.

Agriculture & Industry Abstracts

Developing Regulations for Pesticide Usage on Marijuana Crops in Colorado

Todd Subritzky, National Drug Research Institute, Curtin University, *Simon Lenton*, National Drug Research Institute, Curtin University, and *Simone Pettigrew*, Curtin University

As the first jurisdiction internationally to regulate the commercial production of cannabis, Colorado regulators have faced significant challenges. Chief among these is the regulation of pesticide usage on commercial cannabis plantations. This study aims to outline the complexity for regulators to create standards for the application of pesticides and identify issues that have arisen since the recreational market was implemented in 2014.

The study draws on multiple data sets including: 1) government documents; 2) current regulations; 3) mass and niche media publications; 4) interviews with relevant stakeholders including regulators and farmers; and 5) field notes from the Denver Marijuana Symposium and Canna Grow Expo held in October 2016.

Two core issues have arisen. First, the application of pesticides on marijuana crops is a potentially serious public health risk that needs to be addressed, with concentrated products most concerning. Second is a need for collective learning to fill substantial knowledge gaps due to Colorado being among the first to tackle this issue. Accordingly, the state has drawn on expertise from industry and other stakeholders while limiting regulatory capture.

How to regulate pesticide use on cannabis plantations has been among the most challenging issues for Coloradan regulators. More than four years after the passing of Amendment 64, the state is still searching for workable solutions. However, regulators in Colorado have made strong progress on this complex issue. As Canada, California, and other jurisdictions consider reforming marijuana policy, lessons can be learned from the Coloradan experience.

Perpetual Harvest Prototype: Development of a Unique Vertical Farming Design

Kelly Gehlhoff, Perpetual Harvest, LLC, and *Meral Cooper*, Pueblo Permaculture

Presentation slides: http://hdl.handle.net/10217/180350

Growing cannabis indoors can be quite costly in both energy and water usage, although the benefits include increased potency of the medicinal quality and the ability to harvest year-round. By considering how to maximize the use of floor space and efficiency of both lighting and irrigation, Perpetual Harvest's growing system (PHGS) demonstrates a unique vertical farming design which was innovatively developed to revolutionize best practices in the industry. Rather than replicating other vertical farming techniques that exhibit multiple tiers of growing with LED lights mounted directly above each rack of plants, PHGS grows the plants horizontally towards a light tower of combined wavelengths. The growing beds are approximately the size of a door frame and can house almost 100 plants of smaller size, eliminating the shadow effect that causes the tops of the cannabis plants to be worth more than the bottoms. Each plant produces only one to two ounces of flowers, as opposed to the typical focus of yielding pounds per plant, thus increasing the potency and consistency of the medicine. The plant roots mingle together like a forest in the grow-beds' soilless medium of coconut coir and perlite, instead of being limited by the space beneath each plant site. Irrigation

consists of a simple hydroponic ebb and flow system that hydrates the roots multiple times per day utilizing the force of gravity. Once the viability of PHGS is proven, it will be used to grow edible plant species year-round.

Genetic Tools Weed Out Misconceptions of Strain Reliability in *Cannabis Sativa:* Implications for a Budding Industry

Anna Schwabe, University of Northern Colorado, and *Mitchell McGlaughlin*, University of Northern Colorado

Cannabis sativa is federally illegal and is largely illegal worldwide. However, due to recent state legislation changes, eight states and Washington, D.C. legally allow the sale of cannabis for recreational consumption, and 28 states allow cannabis for medicinal use. Changes in legal status has resulted in an unprecedented surge of newly developed strains, which are usually associated with a *sativa*, *indica*, or hybrid type, based on morphology and reported effects. Strains are propagated from clones or unfertilized seed, and as such, the genetic profile of individuals with the same name should have identical genotypes, regardless the source of origin. Reports of inconsistencies suggest that *Cannabis* strain names are not reliable identifiers. This is likely the result of decades of unregulated trading and growing. Genetic data from ten nuclear microsatellites determined the genetic relatedness of 122 samples in Colorado, California, and Washington. The genetic analyses performed here found no genetic distinction between described *sativa* and *indica* type strains, or hybrids thereof. Moreover, within 12 popular strains acquired from various dispensaries, one strain showed genetic consistency, seven strains had at least one obvious genetic outlier, while four strains showed no genetic consistency. By and large, *Cannabis* strains are inconsistent across state lines, among cities within the same state, among dispensaries in the same city, and surprisingly even between samples of the same strain from the same dispensary. These results undeniably give evidence that strains names are not dependable among dispensaries and that distinction of *sativa*/*indica* is not genetically supported.

Biology & Medical Abstracts

Cannabis in Parkinson's Disease: Growing Like a Weed!

Maureen Leehey, University of Colorado Denver, *Ying Liu*, University of Colorado Denver, *Jacci Bainbridge*, University of Colorado Denver, *Felecia Hart*, University of Colorado Denver, *Christen Epstein*, University of Colorado Denver, *Mary Cook*, University of Colorado Denver, and *Heike Newman*, University of Colorado Denver

The objective of this study was to determine if cannabidiol (CBD) is tolerated and effective in Parkinson Disease (PD) and the dosage needed for a Phase 2 randomized controlled trial. Although there is no conclusive data on the use of cannabis in PD, many patients use it. Evidence suggests that CBD would be well tolerated in PD and may treat some of its motor and non-motor symptoms.

Ten persons with idiopathic PD and intractable rest tremor were enrolled in an open label, dose-escalation study. Subjects started with 5mg/kg/day of CBD (Epidiolex, purified CBD from GW Pharmaceuticals), and escalated at three-day intervals (5 mg/kg/day increase each interval) to 25 mg/kg/day or until a lesser but maximum tolerated dose was reached. The primary outcome, tolerability and safety, was evaluated by adverse events and clinical data. The secondary outcome, efficacy, was assessed with standardized tests on the motor and non-motor symptoms of PD.

Funding was obtained in December 2014; the first subject was enrolled in October 2016. In the meantime, university rules were rewritten and facilities remodeled; the experiment protocol was revised after scrutiny from the university scientific review committee, IRB, and FDA; the study drug source was contracted, and a DEA Schedule 1 and import license were obtained.

Cannabis research in the United States is sorely needed and the regulatory process is complex. The results of this study are presented. It will be followed by a randomized controlled study at the dose determined by this study.

Cannabis-Based Specific and Personalized Treatments for Inflammatory Bowel Diseases: How Far Are We with Cannabis Medicalization

Ramesh Prabu, Volcani Center, *Moran Mazuz*, Volcani Center, *Gopi Silva*, Volcani Center, *Aurel Ion*, Volcani Center, *Maayan Mendelovitz*, Volcani Center, *Oded Sagee*, PLANTEXT, *Orly Hanin*, Meir Medical Center, *Nave Firestein*, Meir Medical Center, *Yoram Kapulnik*, Volcani Center, *Fred Konikoff*, Meir Medical Center, *Timna Naftali*, Meir Medical Center, and *Hinanit Koltai*, Volcani Center

Different preparations of *Cannabis sativa* have been used for the treatment of inflammatory bowel diseases (IBD), including Crohn's disease and ulcerative colitis. However, while *C. sativa* contains hundreds of compounds, the specific beneficial compound(s) remain elusive. For the development of standardized, GMP grade cannabis-based products, the active compounds need to be specified. Israel, via the Ministry of Health, is undergoing a process of medicalization of cannabis, whereby the development of high standard cannabis-based products for specific medical indications is of high priority. Clinical trials in IBD patients have suggested beneficial effects of the unrefined content of the cannabis flower versus refined THC or CBD only. Here we present an approach for identifying cannabis compounds for the use of personalized medicine in IBD patients. We have developed a bioassay and biomarkers that rely on colon biopsies from patients. We show that the anti-inflammatory and cytotoxic activities of cannabis extract on colon tissue and epithelial cells are

derived from a specific combination of cannabis compounds, acting partially via the CB2 receptor. These compounds suppress inflammation and associated markers in both cell and colon tissue cultures. In agreement with clinical trials, anti-inflammatory activity for IBD was not detected with CBD. Our results may pave the way towards patient-specific treatment by standardized *C. sativa*–based products. This study is also discussed in light of the process of cannabis medicalization and the development and use of cannabis strains optimized for specific medical indications.

Aerosols of CBD as Crystalline or Amorphous Dry Powders for Inhalation or Sublingual Delivery, Prepared by CO_2-Assisted Nebulization with a Bubble Dryer

Robert Sievers, Sievers Biotech, and *Lia Rebits*, Sievers Biotech

Supercritical fluid CO_2 is a solubilizing and dispersing fluid used to create micro-emulsions and micro-bubbles of aqueous and organic solutions and suspensions. These fluids can be dried rapidly by decompression and mixing the resulting plumes with warm N_2 or CO_2 in closed-loop or open processing. Purified CBD (at least 99.5% pure) is used which melts sharply at 69-70C, and is odorless and colorless. The formulations of cannabinoids for inhalation or sublingual delivery can be stabilized and desolvated, followed by packaging. In previous work, dry powder aerosols of live attenuated measles virus vaccine delivered to the pulmonary tract with the PuffHaler DPI to 60 adult volunteers was completed in a Phase I clinical trial in which no adverse events were observed. The powders can also be compressed in pellet or wafer forms to administer nutraceuticals and pharmaceuticals by sublingual delivery. Plant extracts, after purifications, can be formulated with amino acids and sugars (e.g., polyols like myo-inositol, polymers like PVP, and surfactants like lecithin). Use of excipients and polymeric additives, such as lecithin or PVP, can act as inhibitors of crystallization to form amorphous dry powder aerosols that are more rapidly dissolved and bioavailable in the amorphous dry powder state than the same formulations in crystalline form.

Marijuana Use and Short-Term Outcomes in Patients Hospitalized for Acute Myocardial Infarction

Cecelia Johnson-Sasso, University of Colorado Denver, *David Kao*, University of Colorado Denver, and *Lori Walker*, University of Colorado Denver

Marijuana use is increasing worldwide. Concomitantly, there has been an increase in case studies reporting adverse cardiac events associated with marijuana use, yet little is known about the impact of marijuana use on cardiovascular outcomes. Therefore, in a retrospective analysis, we quantified outcomes of patients hospitalized for acute myocardial infarction (AMI) with reported marijuana use.

Hospital records for eight states were screened for AMI. Clinical profiles and outcomes in patients with reported use of marijuana were compared to patients where marijuana use was not reported. Patients >70 years old and who also used cocaine, methamphetamines, or alcohol were excluded. In total, 3,854 of 1,273,897 patients with AMI reported use of marijuana upon admission. The composite primary outcome included death, intraaortic balloon pump placement, mechanical ventilation, cardiac arrest, and shock.

There was no association between marijuana use and the primary outcome in multivariate analysis accounting for age, race, payer, and known cardiac risk factors. However, patients who used marijuana had a decreased adjusted odds of in-hospital mortality (OR 0.83, p=0.045) but an increased likelihood mechanical ventilation (OR 1.19, p=0.004) post AMI.

We report several new observations regarding the effect of marijuana use on outcomes following AMI. Most surprisingly, it appears that marijuana use is associated with decreased mortality post AMI.

Cannabidiol-Dependent Modulation of Cognitive Learning and Synaptic Function

Amy L. Uhernik, Colorado State University-Pueblo, *Jose Vigil*, Colorado State University-Pueblo, *Zach Montoya*, Colorado State University-Pueblo, *Adrian Sculptoreanu*, Colorado State University-Pueblo, and *Jeffrey P. Smith*, Colorado State University-Pueblo

The National Institute on Drug Abuse currently lists cannabidiol as having potential therapeutic value for treating neurological disorders that include a strong learning and memory component including anxiety, psychosis, pain, and substance use disorders. It is also being studied for its potential to modulate various neurodegenerative disorders that profoundly affect learning and memory, including Alzheimer's disease. Despite this potential therapeutic importance, the current scientific understanding of exactly how cannabidiol affects various forms of learning and memory, and the underlying cellular mechanisms that it targets, is inadequate to guide its most efficacious and least harmful use for treating such disorders. Our research advances knowledge in this area by showing that cannabidiol modulates trace fear conditioning in mice. These experiments model cognitive learning and memory processes and involve multiple brain regions, including the hippocampus, which has a critical role in the learning and memory disorders listed above, and it is essential for achieving normal trace fear conditioning in rodents. Our work further shows that cannabidiol modulates basal synaptic transmission in mouse hippocampal slices by affecting conduction velocity in the Shaffer collateral and Mossy Fiber pathways, and by modulating synaptic plasticity in these regions. Impulse propagation and synaptic plasticity are essential fundamental mechanisms that support learning and memory, therefore our results present a clearer picture of how cannabidiol might be most useful, and least harmful for treating neurological disorders that have a strong cognitive learning and memory component.

Willingness to Participate in Clinical Research among Patients Taking Medical Marijuana

Marcus Bachhuber, Albert Einstein College of Medicine, *Julia Arnsten*, Albert Einstein College of Medicine, *Joanna Starrels*, Albert Einstein College of Medicine, and *Chinazo Cunningham*, Albert Einstein College of Medicine

Randomized clinical trials of medical cannabis are difficult due to regulatory barriers. Prospective longitudinal studies employing quasi-experimental methodologies may help answer important clinical and policy questions. The willingness of medical cannabis patients to enroll in such studies is unknown.

We surveyed customers of two New York State registered organizations (responsible for growing, processing, distributing, and retailing medical cannabis products). From 30 September 2016 to 13 October 2016, we recruited patients with chronic pain by posting fliers in dispensaries, approaching patients in waiting rooms, and sending out an electronic link via patient newsletters. The survey contained a description of a prospective longitudinal study collecting detailed information about pain, cannabis use, and medication use via cellphones.

Among 396 eligible respondents, 54% were women, with a mean age of 51.1 years. 81% were White, 4.0% were Black, and 9.3% were Hispanic/Latino, of any race. The most common qualifying condition (patients can have more than one) was neuropathy (68%), followed by inflammatory bowel disease

(18%), spinal cord injury (17.9%), and cancer (15%). 95% of respondents believed the study was worth doing, 85% of respondents indicated they would probably or definitely enroll. Of those, 93% indicated they would enroll for six months or more and 80% said they would respond to questions daily or more frequently. The most common reason for wanting to enroll was the potential for research to help others (85%).

Clinical research involving intensive longitudinal data collection from medical cannabis patients is feasible and patients are enthusiastic about it.

Recreational Cannabis Use is Associated with Decreased Use of Prescription and Over-the-Counter Sleep Medications

Julia Arnsten, Albert Einstein College of Medicine, and *Marcus Bachhuber*, Albert Einstein College of Medicine

Presentation slides: http://hdl.handle.net/10217/180339

Cannabis may improve the quality and duration of sleep and help treat various sleeping disorders, but no states have approved medical cannabis for treating sleep disorders. Understanding whether recreational users are using for sleep is important to inform policy.

From August 2016 to October 2016, customers at two recreational cannabis stores in Colorado completed a survey about their use. Customers who had provided a cell phone or email contact received a survey link.

Among 1,492 respondents, 23% identified as medical cannabis users and were excluded from the sample. Of the remaining 1,146 recreational user respondents, 58% were male, 40% were <30 years old, 48% were 30-49, and 11% were >50. One-third had completed college or more, and 35% had attended some college. Two-thirds (67%) were white, 11% Black, and 15% other races, with 17% identifying as Hispanic. 74% (n=844) used cannabis for sleep. Among those who used for sleep, 68% reported using cannabis nightly for sleep and 22% reported using 2-3 times per week for sleep; the vast majority (84%) stated that cannabis was very or extremely helpful. Among those who previously used prescription or over-the-counter sleep medications, 85% (162/190) reported decreasing or stopping prescription sleep medication since using cannabis, and 88% (288/327) reported decreasing or stopping over-the-counter sleep medications since using cannabis.

Among recreational cannabis users, many use cannabis regularly to help with sleep. Users report decreased use of both prescription and non-prescription sleep medications associated with recreational cannabis use.

Rising from the Shadows: A Zellweger Baby's Journey from Hospice to Hope

Meagan Holt, Project PC

Presentation slides: https://hdl.handle.net/10217/184940

Madeline is a four-year-old girl who suffers from a terminal genetic disease called Zellweger Syndrome. This disease destroys the white matter of the brain, and most children don't survive past their first year of life. Zellweger Syndrome has caused Madeline to be deaf, blind, and dependent on a feeding tube. She has been diagnosed with osteoporosis, kidney stones, liver dysfunction, coagulopathy, anemia, low muscle tone, adrenal insufficiency, and in January 2015, developed seizures. They immediately became life threatening and with each new drug we lost more of Maddie. Within two months she tried more than 20 pharmaceuticals, appeared to be near the end of her life, and was admitted into

hospice. The modern medical community was out of options. During the weeks leading up to what we thought would be her last days, we discovered full extract cannabis oil. From that first dose we have watched her come back to life. She no longer requires CPR for seizures, continues to be weaned off her pharmaceuticals, no longer requires opiate medication for pain, is out of hospice, and continues to make improvements. We lack data to know whether this treatment has halted progression of her disease, but we have discovered an effective treatment. This discovery has created hope for families that are told to give up, despite lack of access and concrete research.

Assessment of Safety, Toxicity and Pharmacokinetics of Cannabidiol in Healthy Dogs

Stephanie McGrath, Colorado State University, *Lisa Bartner*, Colorado State University, *Sangeeta Rao*, Colorado State University, and *Luke Wittenburg*, University of California, Davis

Epilepsy is a serious and prevalent disease in both human and canine patients, with drug resistance occurring at an estimated 20-30%. The phytocannabinoid cannabidiol (CBD), has anecdotally shown promise for use as an antiepileptic drug. Here we present the pharmacokinetic analysis and safety of CBD in healthy dogs.

30 healthy dogs were assigned to receive one of three CBD delivery routes (oil, capsules, or transdermal cream) at two different dosages. The medication was continued in each dog for a total of six weeks, during which time examinations, routine bloodwork, and CBD levels were assessed.

Pharmacokinetic analysis demonstrated that the oil formulation resulted in higher Cmax and systemic exposure than the other two routes. The oil appeared to have the smallest amount of intra-individual variability in plasma concentrations and provided equal or greater plasma CBD exposures than the other two routes at each time point. CBD levels were adequately maintained over the course of the study. The most common adverse effect was diarrhea. Mild liver enzyme elevations were present in some of the dogs, but the bile acids remained normal.

This is the first scientific canine study to demonstrate that CBD blood levels were measurable after a single dose of all three delivery methods, and that side effects, when present, were minimal and nonspecific. Further studies in a clinical population of dogs is warranted to assess efficacy but our results demonstrate adequate absorption and maintenance of CBD levels with few adverse effects.

Sources of Analytical Uncertainty in Cannabinoid-infused Edible Testing

Ellen Parkin, EVIO Labs, and *Jeremy Campbell*, EVIO Labs

In the emerging cannabis marketplace, a wide range of cannabinoid-infused edibles are now available to consumers. The diverse matrices encountered in these products present significant challenges for product characterization by analytical laboratories. Several factors may contribute to the overall difficulty in achieving reproducible analysis of edibles. First, the distribution of active cannabinoids is expected to vary within each edible (i.e., non-homogeneity). Secondly, differences in the complex matrices of edible products such as chocolates, baked goods, and gummies may alter recovery of active compounds from the edible matrix during analytical extraction. Finally, mandated dosage limitations for edibles require extremely low cannabinoid concentrations, magnifying the uncertainty of the total dosage when concentration results are scaled to the total edible mass.

In this study, we characterize variability in potency results of three representative edible matrices (gummies, chocolates, and baked goods) using full organic and mixed aqueous-organic extraction methods. Overall, baked goods were found to have the highest variability (up to 46.7%), followed by chocolates (21.0–30.2%), and gummies (up to 20.4%). Differences between employed extraction

systems did not fully account for the observed variance in sample potency. We concluded that non-homogeneous distribution of active cannabinoids within the edible matrices was the primary factor determining the observed analytical variance. Based on this data, guidelines for the minimum percentage of the edible unit that must be subsampled during analysis to ensure reproducible potency characterization.

The Highly Complex Cannabinoid Pathway

Daniela Vergara, University of Colorado Boulder, *Nolan Kane*, University of Colorado Boulder, and *Christopher Pauli*, University of Colorado Boulder

In addition to genetic sequence variation, the function of a gene can also be dramatically affected by variation in copy number. In this work, we present how we established the copy number of the genes from the CBDA/THCA gene family in 67 different varieties of *Cannabis* plants, with the use of whole genome sequencing. Understanding the copy number variation of these genes is crucial in order to determine first, the inheritance pattern of the genes from this gene family between parents and offspring; second, whether gene copy number is related to the amount of THCA/CBDA produced; and third, whether gene copy number is related to the production of other cannabinoids. We find that gene copy numbers in the CBDA/THCA family vary both within and between groups (narrow leaf marijuana type, broad leaf marijuana type, and hemp). Additionally, the copy number of some of the genes does correlate with the production of the cannabinoids. This work demonstrates the importance of gene duplication during the evolution and diversification of *Cannabis*, and shows that the cannabinoids produced may be related to duplication of particular biosynthetic genes.

Cannabinoid Content Analysis: Methodology Review

Remy Kachadourian, Organa Brands

The most popular methods for cannabinoid analysis are gas chromatography (GC), high pressure liquid chromatography (HPLC) and ultra performance liquid chromatography (UPLC). Near infrared technology (NIR) is also being used. This presentation discusses the advantages and limitations of each method, including accuracy, time of analysis, and potential interferences. Gas chromotography with flame ionization detector (GC-FID) decarboxylates the acid form of cannabinoids, and therefore cannot discriminate the acid form from the decarboxylated form. NIR technology is rapid but reliable only over a certain concentration, and limited to four major cannabinoids found in cannabis (THCA/THC, CBDA/CBD). HPLC with ultraviolet detection offers good separation and quantitation for these four and the other 12 major cannabinoids (CBGA/CBG, CBNA/CBN, CBCA/CBC, THCVA/THCV, CBDVA/CBDV, CBLA/CBL) in a 15-minute method, while UPLC can reduce the time of analysis to six minutes. This presentation also discusses the different types of liquid chromotography columns (i.e., C-18, phenyl-hexyl, penta-fluoro-phenyl stationary phases) that can be used and potential interferences of terpenes.

Synthetic and Endogenous Cannabinoids Alter Phasic Dopamine Release and Motivated Behavior

Erik Oleson, University of Colorado Denver

Cannabinoids are pharmacologically defined as a class of chemical compounds—comprising phytocannabinoids, chemically synthesized cannabinoids and endocannabinoids—that bind to the cannabinoid CB1 and/or CB2 receptor. Although the precise historical date varies, it is well accepted

that cannabinoids were one of the earliest phytochemicals used by humanity. Cannabis is the most commonly abused illicit drug in the world. In addition to traditional preparation of cannabis, synthetic cannabinoids are beginning to emerge as a commonly abused illicit drug. Indeed, a recent report indicates that synthetic cannabinoids are the second most used illicit drug amongst adolescents in the United States, trailing only cannabis itself. Despite the widespread use of cannabinoids, until recently, we knew very little regarding the neurochemical mechanisms through which they produce their rewarding effects due to technical limitations. All drugs of abuse are thought to increase dopamine concentrations in the nucleus accumbens. Tonic and phasic dopamine concentrations are thought to arise from two distinct patterns of dopaminergic neural activity occurring in the freely moving animal. A tonic dopamine concentration theoretically originates from dopamine neurons firing in a regular pacemaker pattern of low frequency events (1-5 Hz). Phasic release events theoretically originate from dopamine neurons firing in high frequency bursts (≥20 Hz), and are thought to be critically involved in motivated behavior. Here I will discuss how synthetic and endogenous cannabinoids concurrently alter phasic dopamine release and a variety of ethologically relevant behaviors.

Industrial Hemp Fibers as Reinforcing Agents in 3D-Printing Filament Composites

Nebojsa Jaksic, Colorado State University-Pueblo, and *Melvin Druelinger*, Colorado State University-Pueblo

Presentation slides: http://hdl.handle.net/10217/180348

This paper addresses mechanical and chemical properties of various plastic 3D-printing filament composites reinforced with industrial hemp (*Cannabis sativa L.*) fibers. Hemp fibers are considered an economically advantageous replacement to cellulosic fibers from wood. Namely, hemp is less expensive than wood and it is more environmentally friendly.

3D-printing (additive manufacturing or rapid prototyping) is a novel prototyping and manufacturing process based on material addition. The 3D-printing market is projected to reach $30.19 billion by 2022. Inexpensive 3D printers based on fused deposition modeling deposit plastic filament layer by layer as they create an object. In the last three years, prices of filament dropped threefold. Further price decreases depend on whether the filler material used is less expensive than the plastic filament currently available. Some studies have used wood filler as the reinforcing agent. In this research, the results of hemp-PLA composites are discussed as a possible replacement for wood-PLA composites.

Complementary Analytical Approaches for Describing the Molecular Composition of Cannabis Extracts

Claudia Boot, Colorado State University, *Karolien Denef*, Colorado State University, *Evelyn Bridge*, Colorado State University, and *Christopher Rithner*, Colorado State University

Plants of the *Cannabis* genus produce a diverse array of secondary metabolites including cannabinoids and terpenes that are of interest to growers, manufacturers and consumers. Unfortunately, a lack of standardized methods for extraction and quantification of target compounds has led to confusion about metrics for potency, and a limited understanding about the cultivation factors that influence the diverse chemical makeup of cannabis. We examined the effects of sample preparation on the chemical profiles of industrial hemp samples using a suite of complementary analytical techniques. Sample preparation treatments included cryomilling, mechanical grinding or manual dissociation, and extraction treatments included solvents of varying polarity, as well as a variety of extract filtration devices. Post-preparation extracts were examined with quantitative nuclear magnetic

resonance (qNMR) spectroscopy for major cannabinoid concentrations, and liquid chromatography in-line with triple quadrupole mass spectrometry (LC/MS) was used to validate the NMR method and assess both abundant and low concentration cannabinoids. Gas chromatography in-line with triple quadrupole mass spectrometry (GC/MS) was used for the determination of terpenoid profiles. We found that sample preparation treatments influenced the molecular composition of resulting extracts and we will report on the most effective extraction methodologies. The unique application of these tools provides a comprehensive, sensitive, and reproducible method for assessing the chemical diversity of cannabis-based materials. The application of this analytical method will be useful for understanding the cultivation and manufacturing conditions that drive the chemical composition of cannabis-based products.

Research and Development of Hemp Genetics for the US

John Mckay, Colorado State University

The 2014 U.S. Farm Bill permits cultivation of *Cannabis sativa* for research to study the "growth, cultivations, or marketing of industrial hemp" in states that allow such cultivation. I report on research and development in Colorado, a state that has legal hemp and high THC cannabis. At Colorado State University, we conducted a variety trial of the major cultivars from Europe. These trials were conducted across two years at two locations spanning the latitude and growing conditions of Colorado. I report on the performance of these varieties, investigating the degree to which yield, terpenoids, and cannabinoids are influenced by genetics and the environment. I also report on a genomics collaboration, comparing hemp to United States marijuana strains to understand divergence and diversity across their genomes. I introduce a federally funded multi-state collaboration that includes efforts to define regions of the genome that contribute to yield, gender, and other important traits. Finally, I report on work in the private sector to create new varieties of cannabis that fit into United States production environments, emerging markets, and regulation.

Cannabis Use and Neurological Disability

John Kindred, Colorado State University, *Kaigang Li*, Colorado State University, *Nathan Ketelhut*, Colorado State University, *Felix Proessl*, Colorado State University, *William Shaffer*, Banner Health, *Brett Fling*, Colorado State University, and *Thorsten Rudroff*, Colorado State University

Medicinal cannabis is being legalized throughout the United States, with more than half the states having medical cannabis laws. These laws often pertain to diseases with great personal burdens, especially when related to pain. As cannabis becomes more available it will be increasingly important to determine the long-term positive and negative effects of usage in neurological patients.

The purpose of this study was to identify domains of neurological disability that differ between people with multiple sclerosis (MS) who are and are not using cannabis. An anonymous online survey was hosted on the National MS Society's website from 15 February 2016 to 19 October 2016. The survey consisted of demographic and cannabis use questions, and a modified Guy's Neurological Disability Status (GNDS) questionnaire.

Out of 635 respondents, 141 (93 women) people reported a medical diagnosis of MS. 93 reported currently using cannabis. Cannabis users reported lower disability levels (GNDS CU 23.3 SD 7.0 NU 25.7 SD 6.5, $p=0.049$). Specifically in the domains of mood (CU 1.5 SD 1.6 NU 2.1 SD 1.5, $p=0.033$) and fatigue (2.7 SD 1.8 NU 3.4 SD 1.1, $p=0.034$). Other domains: memory and concentration, vision, speech, swallowing, arm/hand function, mobility, bladder, bowel, and sexual function ($p>0.118$), were

not different.

Cannabis users self-reported lower levels of disability, specifically in mood and fatigue. While differences are statistically significant it will be important to assess their clinical relevance. Future studies investigating cannabis use and people with MS should include assessments of mood and fatigue to verify/support our findings.

Causes and Treatment of Endocannabinoid Deficiency

Michele Ross, IMPACT Network

All humans have an endocannabinoid system and we consume phytocannabinoids each day in spices and other foods. Endocannabinoid deficiency is real, yet not recognized by most medical professionals due to a lack of clinical research and commercially available blood tests. Novel genetic, environmental, and biological risk factors for endocannabinoid deficiency will be reviewed and tools for diagnosis will be explored.

Older women in particular may be at risk for endocannabinoid deficiency due to menopause, and cannabinoid therapy maybe an effective alternative to hormone therapy without the negative side effects. Addressing endocannabinoid deficiency in post-menopausal women may have huge gains in terms of public health and as well as integrate cannabis into a new culture of health.

Education of both health professionals and patients is required to transition to using cannabis as a daily supplement for wellness. The blueprint for building awareness of endocannabinoid deficiency can easily be based on Vitamin D deficiency campaigns. Vitamin D deficiency has finally been acknowledged as a common condition in the United States, despite years of denial by the government.

Marijuana Research at the National Institute on Drug Abuse

Heather Kimmel, National Institute on Drug Abuse

While marijuana is illegal under federal law, more than half the states in the United States have moved to decriminalize or legalize it in some form. Public opinion about marijuana use is rapidly becoming more permissive, while proliferating marijuana dispensaries for medical or recreational use are providing ways to consume marijuana not previously seen before, including marijuana-infused food and beverage products, electronic delivery devices, and emerging marijuana tourism in states with legalized recreational use. We are beginning to learn about some short-term effects of these policy changes; however, many questions remain unanswered about their longer-term public health impacts as well as other social and economic effects. These questions are the focus of intense public and scientific debate as state citizens consider and vote on medical and recreational marijuana laws and as clinicians and policy makers seek treatment and legislative guidance from research findings. One of the research priorities of National Institute on Drug Abuse (NIDA) is to support science addressing public health challenges like those posed by changes in state marijuana laws. NIDA-supported research aims to help inform decision making related to these policies, both in reducing the burden of drug related negative outcomes and in continuing to explore the therapeutic potential of marijuana-derived compounds for pain and addiction. This presentation will describe some of the marijuana policy research currently underway at NIDA, as well as available marijuana research opportunities in the context of overall NIDA priorities.

Investigating the Role of Endocannabinoid-Induced Metabolic Changes on Viral Infection

J. Jordan Steel, Colorado State University-Pueblo

Viruses are obligate intracellular parasites and are dependent on the host cell for energy, nutrients, and biomolecule supplies to replicate. Many viruses have been shown to replicate quicker in cells that have increased metabolic rates and some viruses even encode proteins that manipulate and alter cellular metabolic pathways that will favor virus replication. Similarly, cells that are activated by cannabinoids have an adjusted cellular physiology. Specifically, published research shows that cannabinoid receptor (CB1) activation results in an up-regulation of anabolic pathways such as fatty acid and glucose synthesis. I hypothesize that this metabolically elevated environment in cells with CB1 activation will support higher levels of virus replication than cells that do not have CB1 activation. I am investigating how the endocannabinoid CB1-induced changes on cellular metabolism affect viral replication for two different families of viruses. I will determine if cannabis enhances, inhibits, or has no effect on viral replication in human liver cells. I will also investigate which cellular pathways and enzymes are activated during CB1 activation in human liver cells and compare that to pathways that are activated during virally infected cells. Investigating the impact of cannabinoid- mediated alterations to cellular pathways will advance the field of cannabis research. By concurrently analyzing the impact on viral replication, I will be able to understand the effects of cannabis on viral replication and determine if there are safety or therapeutic clinical applications that apply to cannabis use with viral infections.

Current Science on Cannabis for Post Traumatic Stress Disorder and Future Clinical Trials

Sue Sisley, Scottsdale Research Institute, and *Roberto Pickering*, Battlefield Foundation

There are significant barriers to the Multidisciplinary Association for Psychedelic Studies (MAPS)' research on the use of medical marijuana to treat patients with treatment-resistant Post-Traumatic Stress Disorder (PTSD). This study is a collaboration between the Scottsdale Research Institute, Johns Hopkins University, the University of Colorado, and the University of Pennsylvania. It is supported by a number of sources, including research in lab animals, fMRI imaging in humans, and anecdotal reports from countless health practitioners and patients. Additionally, clinical research in Israel evaluating medical marijuana as treatment for PTSD has been promising. MAPS' study will test four strains of smoked marijuana, each containing different concentrations of active cannabinoids, in two three-week stages, as a pharmacological agent to manage PTSD symptoms among 76 American war veterans. This will be the first randomized controlled crossover clinical trial in the United States testing the therapeutic potential of marijuana for PTSD. The primary measured outcome will be the Clinician Administered PTSD Scale (CAPS-5), alongside extensive secondary outcomes including sleep patterns, depression, withdrawal symptoms, metabolic and inflammation panels, and self-reporting by the patients.

Education & Public Health Abstracts

Educating in the Gap: Integrating Cannabinoid Science into Nursing Practice

Courtney Allen-Gentry, CINCSciences

An estimated 2.5 million patients in the United States, suffering chronic and life threatening conditions, are taking cannabinoid therapeutics without standardized treatment plans or integrated nursing care. This rapidly growing population is critically unserved and unrecognized, lacking nurses educated in current, evidence-based cannabinoid research. Presently 34 states have some form of legalized medical cannabis, often dispensed in retail shops staffed by non-healthcare workers. Patients using cannabis are left on their own to manage complex, life threatening conditions without providers educated to assist with the integration of this powerful medicine into their medical regime. This program introduces the emerging field of cannabinoid nursing, which integrates principles from community public health, holistic and botanical theoretical models. The human endocannabinoid system is a built-in network of receptors, ligands (keys), and metabolic enzymes critical to homeostasis. It is considered the mind-body medicine system believed to govern self-healing. Like endorphins, endogenous cannabinoids provide a feeling of bliss, reduce pain, and activate internal repair. Additionally, endocannabinoids help maintain homeostasis through channels enabling the body to relax, eat, sleep, forget, restore, and protect. Indeed, endocannabinoid deficiency is now linked to Multiple Sclerosis, Irritable Bowel Syndrome, Fibromyalgia and other autoimmune syndromes, all of which highlight the importance of a balanced endocannabinoid system. This presentation introduces a basic understanding of the human endocannabinoid system, its importance to health and wellbeing, and the integration of cannabis as an important emerging therapy in the treatment of multiple conditions and end of life transitions.

Middle School and High School Student Cannabis Use, Prevention and Intervention: Post Legalization

Tim Peters, Colorado State University-Pueblo, *Bethany Kies*, Colorado State University-Pueblo, *Sue Pettit*, Colorado State University-Pueblo, *Jenny Piazza*, Colorado State University-Pueblo, *Margie Massey*, Colorado State University-Pueblo, *Jeremiah Blaha*, Colorado State University-Pueblo, *Jeff Piquette*, Colorado State University-Pueblo, *Pam Richmond*, Colorado State University-Pueblo, *Jonathan Poritz*, Colorado State University-Pueblo, *Bailey Hughes*, Colorado State University-Pueblo, *Molly Lotz*, MEI, and *Ron Wiley*, TriKnot Restorative Consulting

This panel presents and discusses the K-12 Cannabis Research Pilot Study, the purpose of which is to offer information and insight and to identify factors that affect the rate of marijuana use among middle school and high school students in Colorado post legalization. The pilot study includes four elements. The first is an analysis of existing data from state and local agencies that includes the rate of marijuana use among secondary students, vicinity of marijuana dispensaries, and other community and student demographic information to determine trends, patterns and unanswered questions related to factors that influence marijuana use among middle school and high school students. The second element is a survey we administer to Colorado schools to collect data on the types of drug and marijuana education curricula used. We are also conducting studies to analyze the effectiveness of school based curriculum, practices and interventions that prevent and mitigate marijuana use among middle and high school students and address student violations of marijuana use. We are conducting

a study that measures the effectiveness of MEI, a marijuana specific education and intervention curriculum, and also, a study of the use of Restorative Justice as a model for addressing marijuana violations in middle schools and high schools.

Monitoring Health Concerns Related to Marijuana in Colorado: 2016

Mike Van Dyke, Colorado Department of Public Health and Environment

After the legalization of recreational marijuana, the Marijuana Health Monitoring and Research Program at the Colorado Department of Public Health and Environment was given statutory responsibility to monitor drug use patterns, emerging science and medical information relevant to the health effects associated with marijuana use. The goal of this program was to utilize existing data sources to develop a broad picture of marijuana use and health impacts in post legalization Colorado.

Data from Colorado population based surveys were used to assess changes in marijuana use patterns. To monitor potential health outcomes, indicators were developed for the Colorado hospital discharge data and poison center call volume data. This presentation summarizes trends in these data to illustrate the short-term impact of marijuana legalization at the state level. In short, marijuana use data have not shown short term increases in marijuana use among Colorado youth and adults. Hospitalization data and poison center calls show clear increasing trends related to marijuana, though the increases may be explained in part by the change in legal status. Continued long-term surveillance is needed to draw any firm conclusions regarding the effects of legalization on marijuana use and health impacts.

Colorado Marijuana Research Programs from Concept to Reality

Ken Gershman, Colorado Department of Public Health and Environment

This talk provides an overview of the two types of marijuana research grants currently being funded by the Colorado Department of Public Health and Environment. There are currently nine medical marijuana research grants and seven marijuana public health research grants being funded. Also covered are sources of funding, selection of priorities for funding, and specific study designs, topics and goals of funded projects.

Legal & Regulatory Abstracts

Comparing Marijuana Tax Structures

Jared Bressler, Colorado State University-Pueblo, *Serena Fitzgerald*, Western Washington University, and *Melodie Lamborn*, Colorado State University-Pueblo

As recreational marijuana becomes legal in more states finding the best way to tax marijuana is increasingly important. Currently, states tax marijuana with a sales tax based on the price of the product being sold. While different states tax marijuana at different rates they all tax sales based on the price paid. This paper looks at price data from Colorado and Washington and use a regression model to see how closely the current sales tax relates to a tax on THC, resulting in a model that correlates tax structure, consumer incentives, the development of the industry. The model looks at how the sales tax affects firms' incentives relative to quality control and how it affects the state's ability to respond to new information on possible negative effects of different marijuana products. Finally, this paper presents an alternative tax structure that is more responsive to the needs of policy makers and can help the marijuana industry develop into a more mature industry.

Black, White and Green: How Regulations and Taxation Affect the Price Structure of the Cannabis Industry in Colorado

Jim Parco, Colorado College, *David Levy*, United States Air Force Academy, *Austin Davie*, Colorado College, *Phoenix Van Wagoner*, University of Colorado Boulder, and *Haley Parco*, Colorado College

As of November 2016, eight states have passed amendments to their respective state constitutions legalizing full adult-use retail production, sale, and use of cannabis. Additionally, 22 other states have approved legislative policies allowing for the production and sale of strictly medicinal marijuana. With the dramatic change in the legal business environment, previous "black market" operators are now able to operate legally. However, in the face of strict state regulation and taxation (in excess of 20% on all recreational sales), we hypothesize that the black market for adult-use marijuana in Colorado continues to flourish. Using interviews, we investigate the newest entrepreneurs of the "white market" in Colorado as a revelatory case study, and report on motivations and actions in becoming operators in this industry.

Job Quality in Colorado's Cannabis Industry

Brad Gilbreath, Colorado State University-Pueblo, and *Patrick Radigan*, Colorado State University-Pueblo

This study focuses on job quality in Pueblo County's hemp- and marijuana-related businesses. The study draws upon the work of job-quality researcher Arne Kalleberg to construct a thorough assessment of whether the legal cannabis industry is creating good jobs. The study, which is in the data-collection phase, incorporates both economic and psychosocial indicators of job quality. The researchers discuss their job quality indicators, research strategies, and what they have learned about the industry.

Tales from the Field: Methodological Notes on Conducting a Medical Cannabis Regulatory Impact Assessment

Joshua Meisel, Humboldt State University

Legalization of medical and recreational cannabis has not necessarily resulted in normalization and destigmatization for research purposes. The continued prohibition of cannabis by the federal government has contributed to industry actors remaining ambivalent about sharing business and financial information with outsiders. As states have moved towards liberalization of cannabis laws, cannabis industry actors have become more comfortable coming out of the shadows as a pseudo-legitimate industry. Meanwhile, inconsistent messaging about the legal status and enforcement priority of cannabis by the federal government has pushed some back into the shadows of an illicit economic structure. This presentation describes the methodological challenges and remedies in gathering economic data from medical cannabis manufacturers to support a regulatory impact assessment for the California Department of Public Health.

Economic Analysis of New Regulations on Manufactured Cannabis in California

Erick Eschker, Humboldt State University

This paper presents findings from an economic impact analysis of proposed regulations on manufactured cannabis in California. Manufactured cannabis includes extracted oils, baked goods, and topical products, among others. California is required to regulate manufactured cannabis in both the recreational and medical markets by 2018. I discuss the issues related to modeling the manufactured medical and recreational use markets including how to estimate market size, regulatory cost impacts, and price changes after regulation. Of particular relevance is the estimated drop in the risk premium associated with producing cannabis. I also discuss our method for using IMPLAN software to estimate economic impacts given that cannabis is not part of the software's model or data files. I present an overview of the current manufactured cannabis market and present estimates of the impact on state product (GDP) and jobs within the state, as well as estimates of the change in market quantities after regulation and legalization.

"Reefer-Rapaciousness?": The Cannabis Industry Needs to Attend to Both Medical and Recreational Consumers

Fred Krissman, Humboldt State University

A profound cultural revolution is underway, although the final outcome remains unclear. Many cannabis activists are simultaneously celebrating and mourning the outcomes of the 2016 election cycle, as well as bracing for a possible resurgence in fed-led "reefer-madness." A smaller but growing concern is that the push for legalizing recreational marijuana will undermine the medical model first successfully implemented in California in 1998. In the lingo of Californian state agencies, "cultivators," "manufacturers," "distributors," and "consumers" of medical marijuana have all been affected by the recent advent of recreational legalization in Colorado, Washington, and Oregon. A preliminary assessment of the situation in those states suggests that tax revenues and regulatory simplicity have been the primary concerns determining the policies implemented to date. This approach may be at the expense of medical patients who rely on abundant and affordable medicine, as well as many of their suppliers, which could be interpreted as "reefer-rapaciousness." As Humboldt's Institute for Interdisciplinary Marijuana Research conducts state-sponsored assessments of the effects of regulation on both medical and recreational cannabis in California, what lessons can be gleaned from

the three key states that came before us? This presentation outlines the situation for the marijuana industry in those three states that have already combined in various ways the medical and recreational markets, and considers the likely outcomes in California, the state with the largest cannabis sector in the United States.

The Confusing Case of "Legal" Cannabis

Linda Schutjer, Colorado State University

Although about half of the United States has some form of legal cannabis under state law, it remains a DEA Schedule 1 drug under the Federal Controlled Substances Act. A number of laws have been passed at the federal level that attempt to limit the ability of the federal government to enforce the Controlled Substances Act in states that have chosen to allow their citizens to use cannabis. However, rather than clarify the legal status of cannabis, these laws add confusion to an already confusing situation. The fairly recent decision to allow states and institutions of higher education to grow low THC cannabis for research purposes has opened up opportunities to work with cannabis although the guidance coming from the DEA seems contrary to congressional intent in passing such legislation. I review the legal status of cannabis in the United States, focusing on federal law, including a discussion of key legislation and case law with a focus on legislation such as the Drug Free Schools Act that indirectly impact the ability of a university to work with cannabis. I discuss what clearly can and cannot be done with cannabis as well as the grey areas that exist and thoughts on what the future may bring. Finally, I provide some thoughts on best practices for universities that do wish to engage in cannabis research, including accepting donations from the cannabis industry, Schedule 1's, sharing cannabis materials, and the like.

Latinos and Legalization: Assessing the Impact of Cannabis Legalization on Colorado's Latino Communities

Santiago Guerra, Colorado College

In November 2012, Colorado citizens voted to pass Amendment 64 to the Colorado State Constitution, becoming the first state to "legalize" the recreational consumption, possession, and production of marijuana for adults over the age of 21. On 1 January 2014, the law officially went into effect, and recreational marijuana shops opened in Colorado. In the process of promoting the cause of marijuana regulation, the Colorado Campaign to Regulate Marijuana Like Alcohol, as well as other marijuana advocates, also positioned the legalization of marijuana as part of a drug reform initiative aimed at alleviating and remedying the social ills caused by the so-called War on Drugs. As part of this rhetorical process, advocates argued for legalization as a solution to the mass incarceration of people of color for marijuana offenses and an opportunity to empower communities of color through this groundbreaking drug reform. As the largest ethnic minority group in the state of Colorado, and one that has historically been disproportionately impacted by the criminalization of cannabis, Latinos represent a key constituency for understanding the social justice impact of marijuana legalization. Drawing on research with the marijuana regulation movement and with Latino communities in Denver, Pueblo, and the San Luis Valley, this paper offers a critical ethnographic perspective on the race, class, and gender dynamics of marijuana legalization in Colorado. Specifically, the paper highlights the multifaceted impact on Latino communities as a central point for identifying the successes and shortcomings of cannabis legalization.

The Cannabis Catalyst: Creating Change for Better or Worse?

Brad Stevenson, Humanetic Consulting Services, Inc. and Valley Marijuana Council, and *Joe DiSalvo*, Pitkin County Sheriff and Valley Marijuana Council

For some, legalized cannabis is a libertarian economic and medical breakthrough. For others, it's the short-sighted, tragic derailment of a generation of kids and driver of health, safety and productivity barriers. With reality seldom purely black or white, building community capacity to excel in the gray and innovating models for industry stewardship of communities envisions a future on which all can agree. We not only have a chance to sculpt a better systemic approach to the management of "intoxicants," but an evolved approach to engaging with divisive topics. After all, we're in this together.

Legalization of marijuana has been exalted and vilified. Fact-based, conclusive alignment is unlikely any time soon. In these polarizing times, can the challenge and discord over cannabis be a catalyst for social innovation?

In the context of a divided nation, with differences highlighted more than commonalities, the Valley Marijuana Council has forged new collaborative pathways to supporting communities. Harnessing cross-sector, cross-function and industry partnerships, leaders work together to monitor and creatively solve problems by focusing on common sense and common ground stewardship.

Blame it on unique attributes of the product or industry, or pin it on context, legalization presents opportunities for us to rethink the template for responsible and responsive industry partnership and community issue leadership. If we can escape the inertia and associated devastation of past approaches with alcohol, tobacco, and opioids, we fulfill the promise of human potential and evolution, and build a better template for whatever comes next and provide a beacon for change.

The Politics of Cannabis

Cindy Sovine-Miller, Sovine Miller & Company

In this presentation, I review a brief history of the politics that led to cannabis prohibition, and explore the current state of cannabis in politics, with a look like behind the scenes at the far-reaching implications policy makers are struggling with as legalization spreads throughout the world. I dive into the social justice aspects of legalization and review the successes and what work is left to do. I also explore the economic and geopolitical dynamics of the emerging regulated industry as it continues to evolve. I also discuss how cannabis disrupts the status quo for many industries and the political obstacles that face regulated cannabis moving forward. Whether it is in the medical arena, textiles, fuel, or even food, cannabis is reducing its competitors' market share everywhere it is legally available. I discuss how these industries are responding, and the major laws and regulations that Congress and states are currently grappling with, before closing with a look at what the future may hold for cannabis under a new administration.

Building the National Marijuana Museum

Jim Parco, Colorado College, and *Haney Branson*, National Marijuana Museum

With the decisive defeat of Proposition 200 in Pueblo County, Colorado, during the 2016 election season, local business and civic leaders stepped forward and announced plans to construct the National Marijuana Museum to celebrate the rich social, cultural, scientific and anthropological histories of the cannabis plant. We provide an overview of the mission, vision, and concept of the museum, and seek input and feedback from session members on what they would like to see in this institution.

Keeping the Good Faith: How Often Are Cannabis Doctors Sanctioned by California's Medical Board

Mitchell Colbert, Harborside

Presentation slides: http://hdl.handle.net/10217/180354

California was the first American state to legalize medical cannabis in 1996. The industry operated without any regulation until SB420 was passed in 2003, though SB420 did little to regulate the industry, leaving much up to local governments. The California cannabis industry finally saw its first set of statewide regulations in 2015, with passage of the Medical Cannabis Regulatory Safety Act. Few regulations have directly affected the physicians who issue recommendations, and they remain relatively unregulated within the market, despite widespread reports of recommendations being issued in minutes without good-faith medical examinations being performed.

This study seeks to answer the question: When compared to the general population of doctors, do medical cannabis doctors have higher rates of probation, suspension, revocation, and all other types of official sanctions, by the Medical Board of California (MBC)? We define a medical cannabis doctor as a physician (MD or DO) who has written a recommendation for cannabis for any patient, at any time in their career. We have evidence of 36 cannabis doctors being sanctioned by the MBC in some way between 2009 and 2016. During fiscal year 2014–2015 alone, the MBC took actions against 759 doctors; additionally, as of 26 April 2016, the MBC had 445 doctors listed as being on probation.

Our research conclusively shows that cannabis doctors have lower rates of suspension and other official sanctions than their non-cannabis counterparts. Furthermore, when cannabis doctors were sanctioned by the MBC, in many cases it was unrelated to their recommending of cannabis.

Cannabis Education and the Democratization of Medicine: A Pharmacist's View from Both Sides of the Counter

Dean Frankmore, Manitou Movie School

A healthy pharmacy economy involves the transaction of three essential ingredients: the drug, the money, and education, or patient counseling, as the profession calls it. Take away the last essential ingredient of education and the transaction is little better than street-corner drug dealing. Such is the conundrum that our communities now face with the burgeoning cannabis trade.

Why is education so important in the drug trade, and why is it especially critical to the commerce of cannabis? These are the two main questions I address from a unique perspective informed by 15 years as a practicing pharmacist and more than 20 years as a medical marijuana patient. This combination of both professional and personal experience shows the great challenges and opportunities presented by this controversial but increasingly promising "green medicine."

The evidence is undeniable, when compared to the vast majority of all other drugs—illicit, recreational, and pharmaceutical—the versatility, safety, and effectiveness of cannabis far exceeds the rest. Yet, in considering that this drug of choice has a half-dozen routes of delivery, an infinite range of dosing options, a multitude of varieties and strains to choose from, as well as cannabinoid profiles to consider, both the challenge and opportunity is clear: each person can tailor their medicine according individual needs and preferences. So too, such a democratization of medicine demands significant public and patient education. How best to meet this demand is the final question addressed.

Cannabis: Is it Time for Regulatory Oversight?

Sanford Wogel, Cannabistry Labs, and *Christopher Van Gundy*, Keller and Heckman

Cannabis products including edibles, lozenges, vaping products, and other derivatives of *Cannabis sativa* such as cannabidiol oils (CBD) are becoming increasingly mainstream. The FDA, for example, has approved an initial new drug application for Epidiolex™, a CBD product used to treat epilepsy in children. Recent voter initiatives have legalized medical and/or recreational marijuana in 28 states and Washington, D.C., but some states, particularly California, will not have regulations in place for some time. With the development of this substantial emerging market arise conflicting state and federal laws and policies, and regulatory uncertainty. Consequently, entrants to this unexplored corner of the cannabis industry face unknown and potentially large legal liabilities. This presentation briefly describes the evolution of laws pertaining to cannabis products such as cannabis-infused edibles and vaping products, including key case law and guidance documents, and proposes strategies for cannabis companies to navigate their way legally through this conflicting landscape.

Social & Geography Abstracts

Consumers' Perspectives on the Function of Cannabis in Their Lives

Robin Harwick, University of Washington, *Tatiana Masters*, University of Washington, and *Beatriz Carlini*, University of Washington

The dichotomy between medicinal and recreational cannabis present in many states' laws reflects the way United States science and policy have approached cannabis use for many decades. However, recent research suggests that boundaries between these two types of cannabis use—firmly delineated in public policies—seem quite blurred to consumers. In both clinical and community samples, medical and non-medical cannabis consumption often overlap, and consumers may transition over time from medical to non-medical use or vice-versa. This grounded theory study aims to understand cannabis consumption from the perspective of adult regular consumers, without preconceived ideas that their use is defined by current categories of medicinal or recreational (non-medical). Participants who defined themselves as regular cannabis consumers were recruited for focus groups. Participants (n=22) ranged in age from 21 to 77. The participants shared their perspectives on cannabis's functional utility across their life course along with their different motivations, settings, and contexts for consumption. This presentation reports preliminary findings and emerging themes that will be used to produce a taxonomy of how these adults perceive cannabis's function(s) in their lives and discuss how these themes are different between age groups and across the life course.

Self-Reported Recreational Cannabis Use Characteristics, Motives for Use, and Effectiveness

Julia Arnsten, Albert Einstein College of Medicine, and *Marcus Bachhuber*, Albert Einstein College of Medicine

Presentation slides: http://hdl.handle.net/10217/180338

Little research has investigated the demographic and symptom profile of recreational cannabis users in states with legal use.

We surveyed customers of two recreational cannabis stores to examine demographic characteristics, motives for use, medical symptoms, and perceived effectiveness. From August 2016 to October 2016, customers who had previously provided a cell phone number or email address received a link to an online survey.

Among 1,492 respondents, 23% identified as medical cannabis users and were excluded from the sample. Of the remaining 1,146 recreational user respondents, 57% were male, 40% were <30 years old, 48% were 30-49, and 11% were >50. One-third had completed college or more, and 35% had attended some college. Two-thirds (67%) were white, 11% Black, and 15% other races, with 17% identifying as Hispanic. 40% were current cigarette smokers, most respondents (72%) reported drinking alcohol <once/week, and 20% reported having an alcohol-containing drink 2-3 times per week. 58% described their primary desired cannabis effect as either: relief from stress, pain or discomfort (17%), relaxation (33%), or sleep (9%). 65% reported that they used cannabis for pain, and 74% for sleep; over 80% reported that cannabis was very or extremely helpful for these symptoms and that they had decreased their use of prescription or over-the-counter medications. Women were significantly more likely than men to use cannabis for both pain (75% v. 67%) and sleep (81% v. 72%). Recreational cannabis users reported that cannabis was an effective treatment for diverse symptoms.

The Consumer-BudTender Interface in Assessing Medical Marijuana

Lloyd Covens, West420 Media

Sick and medically-challenged consumers looking for reliable information about the potential use of medical marijuana have few healthcare-provided resources, leaving many to seek advice from several unconventional sources. Beyond the internet, consumers hoping to explore CBD-only and possible CBD/THC combinations have a myriad of questions, and this study explores the early interface between budtenders and consumers, highlighting the nature of consumer-requested information and levels of anxiety over initial cannabis use.

While in some 26 states, the provision of a physician supported examination leading to the issuance of a medical card is possible, this research surveys Oregon and Colorado combination dispensaries to examine the growth in self-medicating alternatives. What are the initial consumer expectations? What is the relationship between certain conditions—chronic pain, anxiety, inflammation, spasticity and neuro-protection—and the desire to forego a medical recommendation to directly treat conditions through adult-use purchases? Is there an expectation to seek physician or nurse interaction at a later time? What is the role played by "word-of-mouth" and anecdotal evaluations for medical cannabis options?

Energy and Water Use in Cannabis Cultivation

Leonardo Bedoya, Colorado State University-Pueblo, and *Jane M. Fraser*, Colorado State University-Pueblo

Presentation slides: http://hdl.handle.net/10217/180254

The newly developed supply chain system involving the production and distribution of high and low THC cannabis in Pueblo County must be evaluated in terms of the impact on the use of energy and water. Our study determines the energy and water use in cannabis cultivation and production and creates a simulation model to project the effects under different scenarios.

Estimates of energy and water use vary. Some of the variation is explainable by strain, time of year, environment (indoors or outdoors), and other parameters. Many estimates are done where growing is illegal, so must be inferred. More data are becoming available from legal cultivation, but must be evaluated for applicability in Pueblo County. We will collect and review data to determine likely energy and water use.

A simulation-based system dynamics model will be developed to analyze the impacts on energy and water use by this new supply chain. The model includes population and housing sectors, residential, commercial, and industrial energy and water consumption, regional and business attractiveness, and land utilization and water rights. The model will analyze the details of the production process including main products and their by-products, and resource utilization. The products will be divided into different market sectors (medical, recreational, nutritional). Once the model is built, several scenarios will be analyzed such as environmental policies related to water and land use, CO_2 emissions, impact on related and non-related business attractiveness in the region, and taxation.

Land Use, Water, and Policy Considerations in Emerging Cannabis Markets: Lessons from the Arid Mountain West

Jason Adam Kikel, University of New Mexico

Colorado's voter-approved Regulate Marijuana like Alcohol Act of 2012 made the state the first to

legalize the sale, taxation, and possession of marijuana through a commercial, adult-use market. As part of the expansion from the state's existing medical marijuana regulatory system, local governments were given the choice to ban or permit and regulate cannabis cultivation and retail sale within their jurisdictions.

One jurisdiction, Pueblo County, opted to permit cannabis cultivation, manufacturing, and adult-use retail stores (dispensaries). Concurrently, resource constraints, including limited water availability, have created problems for cultivators, as the transition from existing medical markets and informal "gray-market" cultivation has created challenges for local land use regulators and utility providers.

Qualitative research methods to develop this paper include content and relational analyses of zoning compliance information as well as interviews with county land use officials, water managers and regulators, and three licensed marijuana cultivators. Interview questions focused on the federal, state, and local policies that influence local regulation and cannabis cultivation development.

This paper establishes a framework for communities in evolving cannabis markets and recommends action for communities considering local land use regulations in light of state-level legalization.

Hemp: 100% Renewable Energy, Soil Remediation and Waste Diversion

Meral Cooper, Colorado State University-Pueblo and Pueblo Permaculture, *Kelly Gehlhoff*, Perpetual Harvest, LLC, and *Clinton Cooper*, Perpetual Harvest, LLC

Presentation slides: http://hdl.handle.net/10217/180349

The renewable energy marketplace is expanding rapidly and is more economically viable than ever before. One of these options is plant-based biofuels, particularly the use of the hemp plant, for more than 50,000 industrial uses. By analyzing and evaluating new technologies for extraction and application of all parts of hemp for food, fuel, fiber and medicine, this study will determine how likely it is that hemp becomes a competitive source of renewable energy. Also, this research will look at finding ways to use or compost hemp and cannabis industry waste and what kinds of infrastructural investments and legal changes would be required to make this a possibility, especially in a city such as Pueblo, Colorado. Also included will be an economic analysis regarding how the hemp plant can remediate depleted soil in Pueblo County and provides economic opportunities for local farmers. Seeking both global and national studies as input, a plan for localized prioritization of hemp in the Ready for 100 Campaign (focused on the social transition towards 100% renewable energy production) promoted by the Sierra Club will be created. Current data from other countries that have implemented the use of hemp at the large scale and local industry interviews will be used to collect most quantitative and qualitative data. The use of the hemp plant as a source of sustainability needs to be examined closely.

An Analysis of Cannabis Advertisements in Colorado for the Sale of Legal Cannabis

Joanne Gula, Colorado State University-Pueblo, and *Jiaxi Shen*, Colorado State University-Pueblo

Cannabis was legalized in Colorado on 6 November 2012. It is illegal to advertise dispensaries that sell these products using any electronic source or social media that sends a signal beyond Colorado's borders. However, print advertisements are legal and are used by dispensaries in very competitive ways. This presentation examines print advertisements for cannabis from three cities in Colorado (Denver, Colorado Springs, and Pueblo) that are published in local news magazines. These publications were collected from July 2015 until January 2016. There are hundreds of advertisements available for analysis. The dispensaries included in this study sell medical and recreational cannabis in combination; medical cannabis dispensaries were excluded and will be analyzed in a separate study.

Advertising appeals and incentives were coded into categories used to sell these products. Sellers create many appeals and tactics to entice consumers—coupons, apps, discounts, holiday specials, and rewards cards, to name a few. The advertisements were also examined for size, color, visuals, headlines and other design and copy aspects created to attract the consumer's attention and get them to purchase their cannabis products. This research is the first of its kind and will be the beginning of future studies.

Green Lung: Mold Exposure and Cannabis Workers' Health Research in Colorado

Marty Otañez, University of Colorado Denver

What level of risk does exposure to mold pose for workers in cannabis cultivation facilities and trimming rooms? What strategies exist to increase worker protections and hold cannabis companies accountable to practices that harm occupational health? Applying visual and critical medical anthropology approaches, the researcher presents findings on a pilot study of cannabis workers, powdery mildew, and workplace protections in Colorado's cannabis industry. Individuals who devote their labor to the production of legal cannabis are exposed to varying levels of mold spores with subsequent problems of respiratory problems, skin irritations, and other health risks. Workers with mild or severe asthma, and those with a compromised immune system, tend to be the most vulnerable to mold spores and powdery mildew. While workers want to protect their health and reduce exposure to mold and powdery mildew at job sites, company owners and managers appear to push out product infused with varying degrees of mold and powdery mildew to meet profit making goals. Data from surveys about health conditions completed by cannabis workers, videotaped interviews with cannabis workers, and results from air sampling strategies in grow houses are presented. After this presentation, participants will be able to describe three visual ethnographic methods in cannabis studies and critical medical anthropology, and identify best practices for setting standards and policy that promotes occupational health and corporate accountability in the cannabis sector.

An Exploratory Study of Companies in the Cannabis Supply Chain

Dan Krause, Colorado State University, and *Mellie Pullman*, Portland State University

Presentation slides: http://hdl.handle.net/10217/180252

In this exploratory study, we examined cannabis business practices at three levels: growers, value-added innovators and middlemen, and retailers. We sought to understand their businesses from both the operations and supply chain perspectives. During our case study visits, which took place primarily in Colorado and Oregon, we queried managers and owners about their companies' competitive priorities, specifically in terms of quality, cost, delivery, flexibility, innovation, and sustainability. For growers, we sought to understand the nature of their operation, in terms of size; grow environment; and primary customers. For value-added innovators (e.g., edibles, oils, balms, salves), we focused on understanding their innovation processes, how their products fit into the market, and the potential to scale their businesses. For retailers, we focused on the characteristics of their customer base, including medical and recreational users, and their related preferences for flower, concentrates, and edibles. Although we initiated this study with a formal interview protocol to guide our questions, the exploratory nature of our case research allowed interviewees to expand on relevant areas. The companies we studied were chosen based on availability of contacts and the relative willingness of company owners and managers to openly discuss the nature of their businesses.

The Effects of Marijuana Businesses on Residential Housing Prices

Jim Parco, Colorado College, *Haley Parco*, Colorado College, *Phoenix Van Wagoner*, University of Colorado Boulder, *Jacqueline Dugan*, Colorado College, *Pedro de Araujo*, Colorado College, and *Noah Cutter*, Colorado College

The 2014 legalization of cannabis sales in Colorado led to the promulgation of municipal regulations to mitigate potential negative effects of these newly licensed businesses on their surrounding communities. However, the rhetoric from opponents to legalization efforts has used "negative impacts on residential home prices" as a primary argument. This study focuses on three classes of regulatory licensing: retail stores, manufacturing facilities and cultivation operations in relation to residential housing prices in several counties in Colorado and Washington—the first two states to legalize regulated retail marijuana. Firms within each of these classes have the potential to affect surrounding residential property values in different ways. Using six years of geo-coded data on home sales and using several counties within the state of Virginia, which has no legalization, as a control group, we analyze the effects of cannabis businesses on residential property values since legalization. We find that houses sold after the legalization of marijuana sell for a higher transaction price than houses sold before legalization, while closer proximity to marijuana businesses decreases the housing transaction price.

Location, Location, Smokation: How Store Location Impacts the Sales of Recreational Marijuana

Andrew Robson, Colorado College, and *Jim Parco*, Colorado College

In Washington, an entirely new market of legal marijuana has just opened. Governments are still unsure how to properly handle the situation. Research is quickly being done but because this is a relatively new phenomenon, very little research exists to help people and governments understand the full impact of legalization. This paper seeks to expand that knowledge by establishing what makes a recreational marijuana store successful based on its location. This paper examines the relationship that store sales have with bordering a neighboring state or Canada. It also examines the effects of the demographics of the city that the recreational marijuana store is based in. Specifically, it discusses the impact of median household income in the city and how the county voted in the 2012 presidential election. The study finds that bordering Idaho or Oregon will hugely boost the sales of recreational marijuana as out of state residents flock to purchase legally. This paper finds that bordering Canada has the opposite effect. Median household income was found to be largely inconclusive. This paper also found that, at the 90% confidence level, a county with a higher percentage of votes for Obama in 2012 correlates to elevated marijuana sales.

Cannabis Tourism in the United States

Rachel Giraudo, California State University, Northridge

This paper examines the current status of cannabis tourism in the United States. It begins by addressing how to approach the study of cannabis tourism: Is cannabis tourism primarily a form of drug tourism, or are there contexts in which it is better analyzed as another form of tourism, such as gastronomic or heritage tourism? Focusing primarily on Colorado and California, two states that have legalized recreational, adult-use cannabis, this paper explores the types of cannabis-related destinations and activities currently available, and further examines the demographics of cannabis tourism operators and tourists along with their motivations. Colorado, the epicenter of the so-called Green Rush, has

already realized enormous development in this sector with its organized tours to grow facilities and dispensaries, specialized accommodation and transportation, cannabis cooking classes, and the like. Meanwhile, California is poised to become a major cannabis destination where tourists can travel to grow areas and facilities to see firsthand how cannabis is produced and sample it on-site, such as with wine tourism, and can learn about grow culture and its regional history. The state is well known for its high-quality cannabis, and growers have already begun the process of officially demarcating cannabis appellations, where connoisseurs and newbies alike can experience cannabis terroir. Finally, this paper discusses some of the successes and challenges of cannabis tourism, and highlights relevant issues in the nascent study of this industry.

Panel Abstracts

Southern Colorado Land and Cannabis Research Center Opportunity

Travis Nelson, Colorado Cannabis Growers Association, and *Uma Dhanabalan*, Total Healthcare THC

Located in a most pristine location in beautiful Huerfano County is Indian Pools Ranch. These 1,200 acres located on a hilltop are located on Interstate 25 and Colorado Highway 69 bordering the city of Walsenburg. Indian Pools Ranch is owned by the Faris family, who have made six ten-acre campus sites available for a 20-year lease for $1. These campsites will become a campus for faculty and students from around the world to conduct research on hemp and cannabis. At least one of these ten-acre sites may one day serve as a satellite campus for the Institute of Cannabis Research at Colorado State University-Pueblo. This project is widely supported by the city of Walsenburg.

Sexuality & Cannabis, Do They Mix?

Jordan Tishler, Inhale MD

Presentation slides: http://hdl.handle.net/10217/180253

Sexuality is a fundamental part of the lifecycle for most people, and difficulties can lead to loss of self-esteem, depression, anxiety, and interpersonal strife. Despite its normality, half of men and nearly half of women are troubled by some form of difficulties with sexuality at some point in their life. Difficulties go far beyond erectile dysfunction (ED) in men and low libido in women and occur in four phases: interest, arousal, orgasm, and satisfaction. Few people ever address these issues with their care team, despite evidence that three quarters of their providers are willing and able to be helpful. Part of this stems from the assumption by both patients and providers that—beyond the phosphodiesterase inhibitors, which work only for ED in men—there is little to be gained from therapeutics.

Cannabis therapy can provide a more effective, cross-gender solution to a broad range of these sexual difficulties. In a largely dose-dependent manner, cannabis has been shown to improve function in all four of the domains mentioned above. I discuss data, clinical scenarios, and practice of treating sexual dysfunction with cannabis. I also briefly discuss how cannabis can be used to improve sexual relations in people for whom dysfunction is not currently a problem.

Shifting the Healthcare Paradigm: Cannabis Leads the Way

Donna Shields, Holistic Cannabis Academy, *Michele Ross*, IMPACT Network, *Donna Wade*, Holistic Cannabis Practitioner

The United States healthcare system is in desperate need of repair, considering spiraling insurance premiums, expensive procedures, and an opioid crisis, as well as a disillusioned and chronically ill patient population. Empowering patients and their providers means looking at medicine through a different lens—a lens that features a holistic, integrative approach with cannabis as a key component in the practitioner's toolbox. This session features a road map of how allied health professionals, advocacy groups and educational organizations can shift the healthcare paradigm to lifestyle medicine with improved patient outcomes, most often with reduced costs and side effects.

While a handful of clinicians are doing it right, health professionals, ranging from the health coach to the MD, need practical cannabis medicine training. Learn how one specific online cannabis training

program, geared specifically to the needs of the health professional, is filling the educational gap with an approach that integrates cannabis into a holistic model rather than the allopathic pharma model. Once trained, new cannabis careers are a huge opportunity for those from all walks of life. Follow one student's journey on becoming cannabis competent to build a cannabis coaching career. Advocacy, critical for dispelling the cannabis stigma, also plays an important role in meeting this growing educational demand. An innovative neuroscientist reveals what advocacy projects are getting funded and how you can get involved from the ground up.

Medical Cannabis: An Oxymoron? Discourse Analysis of Interviews with Israeli Physicians

Yuval Zolotov, University of Haifa, *Simon Vulfsons*, Rambam Healthcare Campus, and *Sharon Sznitman*, University of Haifa

Physicians play a major role in medical cannabis authorization; yet, no previous study has used qualitative methods to investigate the integration of cannabis into the medical domain. 25 Israeli physicians were interviewed in order to understand in-depth their views and perceptions on the recent introduction of medical cannabis and the applications for practice. Discourse analysis was performed to examine the discursive practices which were used to construct physicians' views. Physicians exhibited two major discourses about medical cannabis: "cannabis as a non-medicine" and "cannabis as a medicine." Medical cannabis was described as being in clash with core elements of the biomedical model, such as evidence-based evidence, which provoked unwanted uncertainties. Physicians portrayed restricted scientific boundaries to medicine, and cannabis was perceived as an outsider and was marginalized as a dangerous drug of abuse. In contrast, discursive practices to construct cannabis as a medicine included emphasis on positive clinical experience and critical views on the biomedical model. Medical cannabis as a justified alternative was framed as compassionate, mainly for palliative care. The two contrasting discourses reflect the many doubts and complexities that accompany the integration of cannabis into the medical domain. Physicians seem to undergo many struggles in this newly developed area of medicine, which may indicate a barrier to policy implementations. As new policies are being considered around the world, a thoughtful account of physicians' perspectives may serve to enable an appropriate implementation of policies. Greater awareness of physicians' conflicts may additionally facilitate the design of appropriate educational models.

The Medicine Speaks if We Learn to Listen

Albert Two Hawk, Tenth Generation Healer, Lakota Nation, and *Sophie Mae Two Hawk*, Sanford School of Medicine

Albert and Sophie Two Hawk share a deep personal understanding of the tensions between cannabis-friendly traditional healing and cannabis-hating mainstream medicine. Among many other pursuits, Albert Two Hawk is a tenth-generation Lakota Healer with a lifetime of experience using cannabis as a natural medicine. Sophie Two Hawk is the first Native American woman to become an MD in South Dakota. This panel will reveal their perspective about the benefits of fusing traditional and mainstream medical uses of cannabis.

Sex Differences in the Regulation of Energy Homeostasis through Endocannabinoid Signaling within the Hypothalamic Energy Balance Circuitry

Edward Wagner, Western University of Health Sciences

There are myriad examples of sex differences in cannabinoid-regulated biology ranging from abuse liability to antinociception to energy balance. The work in my lab over the years using our guinea pig animal model has revealed sex differences in the latter; with orchidectomized males exhibiting comparatively greater hyperphagia and hypothermia than their ovariectomized female counterparts. These sex differences are further sculpted by the activational effects of gonadal steroid hormones; with estradiol in females markedly blunting the hyperphagic and hypothermic effects of cannabinoids, and testosterone per se in males producing a hyperphagic effect that is blocked by CB1 receptor antagonists. This latter observation indicates that androgens augment endocannabinoid tone to elicit increases in energy intake. These sex differences in, and gonadal steroid hormone influences on, the cannabinoid regulation of energy balance can be resolved down to the level of the hypothalamic energy balance circuitry. For example, estradiol dramatically attenuates not only the ability of exogenously administered CB1 receptor agonists to presynaptically inhibit excitatory glutamatergic input onto appetite-suppressing proopiomelanocortin (POMC) neurons, but also retrograde endocannabinoid-mediated inhibition of these cells brought on by depolarization-induced suppression of excitation (DSE). By contrast, testosterone enhances to potency of CB1 receptor agonists to presynaptically inhibit glutamatergic input onto POMC neurons, and accentuates endocannabinoid-mediated inhibition of these cells via DSE. The source of this endocannabinoid-sensitive glutamatergic input arises, at least in part, from steroidogenic factor-1-expressing neurons in the dorsomedial region of the hypothalamic ventromedial nucleus. These sexual disparities have important implications for the treatment of cachexia and obesity.

Project 22: A New Beginning

Blake Bell, Well Suited for Life, and *Timothy McGettigan*, Colorado State University-Pueblo

Presentation slides: http://hdl.handle.net/10217/180868

The U.S. Department of Veterans Affairs (VA) estimates that, due to post traumatic stress, 22 veterans take their own lives every day. Project 22 intends to bring this little-known calamity to the attention of the American public. In addition, Project 22 sheds light on the fact that the administration's efforts to treat post traumatic stress with opioids compounds the problems of vets dealing with post traumatic stress. By contrast, there is a fast-growing pool of scientific evidence that cannabis offers a much more effective treatment. Project 22 presents evidence that, if the VA were to switch from prescribing opioids to cannabis, the number of vets who commit suicide from PTS could decrease dramatically.

Cannabis and Social Justice

Sue Sisley, Scottsdale Research Institute, and *Timothy McGettigan*, Colorado State University-Pueblo

The criminalization of cannabis has prevented the public from benefiting from this woefully misunderstood plant. In this panel, participants debunk the "Reefer Madness" myths that have stigmatized cannabis as a threat to public health. Panelists discuss medical findings which suggest that cannabis is among the best natural medicines on the planet and that blocking access to cannabis constitutes an egregious act of medical malpractice.

Cannabis and Social Justice, Part II

Timothy Tipton, Colorado State University-Pueblo, and *Timothy McGettigan*, Colorado State University-Pueblo

A continuing discussion on how the criminalization of cannabis has prevented the public from benefiting from this woefully misunderstood plant. In this panel, participants will debunk the "Reefer Madness" myths that have stigmatized cannabis as a threat to public health. Panelists will discuss medical findings which suggest that cannabis is among the best natural medicines on the planet. Blocking access to cannabis constitutes an egregious act of medical malpractice.

Poster Abstracts

Cannabis Use and Physical Function in People with Multiple Sclerosis: A Pilot Study

Nathan Ketelhut, Colorado State University, *John Kindred*, Colorado State University, *Felix Proessl*, Colorado State University, and *Thorsten Rudroff*, Colorado State University

Currently available disease modifying and symptomatic therapies do not sufficiently relieve symptoms of Multiple Sclerosis (MS) and Parkinson's Disease (PD). Consequently, patients are using and looking for alternative therapies, such as cannabis. The purpose of this study wasto compare cannabis use characteristics between individuals with PD and MS. An anonymous online survey was hosted on the National MS Society's and Michael J. Fox Foundation websites. The survey comprised demographic, neurological disability, and cannabis use questions.

635 individuals responded, with 454 reporting a diagnosis of PD and 141 with MS. 36% (n=165) of PD respondents stated they currently use cannabis, while 66% (n=93) of MS respondents reported cannabis use. Most users in both groups have been using cannabis for more than 1 year (PD n=111, MS n=78). 60% (n=56) of individuals with MS use cannabis every day, whereas 40% (n=96) of individuals with PD reported daily use. In both groups, >50% of respondents indicated not having a state sponsored medical cannabis card (PD Yes=61 No=98; MS Yes=45, No=48). In MS, 78% reported the reduction of other medications due to cannabis compared to only 48% in the PD group. Both populations reported similar efficacy of cannabis (0-7 Scale, PD 6.2 SD 1.8, MS 6.9 SD 1.6).

Our data suggests varying use characteristics in PD and MS, with a more common and every-day practice across individuals with MS. Future research is needed to establish specific use guidelines for cannabis in neurological populations.

Efficacy of Standardized, Cannabis-Based Formulations for the Management of Chronic Noncancer Pain

Kenton Crowley, Palliative Care Corporation, and *Guillermo Moreno-Sanz*

Winner of the ICR 2017 Best Poster Award

Pain management is the most commonly reported reason for seeking medical cannabis, which is associated with 64% lower opioid use, fewer medication side effects, and better quality of life in patients with chronic pain. The aim of this study is to assess the efficacy of standardized, cannabis-based formulations for the management of chronic noncancer pain (CNCP).

An observational, longitudinal study was conducted over 12 weeks and was completed by 42 participants. Inclusion criteria were positive diagnosis of CNCP and willingness to incorporate cannabis to their pain management regime. A numeric analog scale (NAS) was used to determine self-reported pain, before and at different time points (1, 4, 8 and 12 weeks) after treatment. Additional observations included reduction of opioid medication and occurrence of adverse events that would cause participant's abandonment.

An average reduction in NAS pain score of 4.9 points was observed (from 7.2 pre-treatment to 2.3 post-treatment, with all of participants reporting some degree of improvement), which represents a 68% reduction. Duration of treatment beyond the first week did not further increase the magnitude of NAS reduction. Additionally, 85.2% of participants using opiates reduced or discontinued their use

of opioid medication and none withdrew from the study due to intolerable side effects.

Our protocol using standardized cannabis-based formulations may represent an effective and safe approach to the management of chronic noncancer pain.

Effects of Medicinal Cannabinoids on Seizures in Adults with Medically Refractory Epilepsy

Barbara Brett, Colorado State University-Pueblo, *Katherine Freeman*, Colorado State University-Pueblo, and *Matthieu Conroy*, Colorado State University-Pueblo

Approximately 20–40% of people with epilepsy struggle to control their seizures with traditional medications. This condition, referred to as medically refractory epilepsy, significantly affects patients' quality of life in numerous ways including increased social isolation, increased rates of comorbid psychiatric disorders, and increased mortality. Moreover, patients taking traditional anti-convulsant medications report numerous cognitive and behavioral side effects. A potential adjunctive treatment for epilepsy that may be beneficial and carry fewer side effects is medicinal cannabis. Cross-sectional studies indicate that approximately 16–21% of adult patients with epilepsy smoke marijuana, with some reporting positive effects such as decreased seizure frequency. Current research in humans and in animal models specifically points to the possible therapeutic potential of one particular cannabinoid—cannabidiol (CBD)—due to its documented anti-convulsant, anti-inflammatory, and neuro-protective effects. Therefore, the purpose of the present prospective observational pilot study is to characterize the physiological effects of CBD-rich medicinal cannabis on adults with medically refractory epilepsy who elect to use medicinal cannabis. Study participants are asked to wear an E4 wristband (a wireless physiological recording device) daily for two months before they begin using CBD-rich medicinal cannabis and for four months after they begin use. Physiological measures including electrodermal activity, blood pulse volume, motion, temperature, and seizure frequency are collected for analysis. Questionnaire data assessing side effects and participants' perception of their quality of life before and after medicinal cannabis use are also collected. Progress on this study to date will be discussed.

Early Adopters: Profiles of Patients with Chronic Pain Registered for Medical Cannabis in New York State

Marcus Bachhuber, Albert Einstein College of Medicine, *Julia Arnsten*, Albert Einstein College of Medicine, *Joanna Starrels*, Albert Einstein College of Medicine, and *Chinazo Cunningham*, Albert Einstein College of Medicine

In January 2016, New York's first medical cannabis dispensaries opened to the public. Little is known about the population of patients with chronic pain who take medical cannabis. We surveyed customers of two registered organizations (responsible for growing, processing, distributing, and retailing medical cannabis products). From 30 September 2016 to 13 October 2016, we recruited patients with chronic pain by posting fliers in dispensaries, approaching patients in waiting rooms, and sending out an electronic link via patient newsletters.

Among 396 eligible respondents, 54% were women, with a mean age of 51.1 years. 81% were White, 4.0% were Black, and 9.3% were Hispanic/Latino, of any race. 39% had a household income over $80,000 per year and 60% had a college or graduate degree. The most common qualifying condition (patients can have more than one) was neuropathy (68%), followed by inflammatory bowel disease (18%), spinal cord injury (17.9%), and cancer (15%). Respondents reported having chronic pain for a mean 21.7 years, with a mean Brief Pain Inventory pain level of 6.6/10. 74.1% of patients reported

taking pain medication in the past month, with 50% of those taking opioid analgesics for a mean 24 days of the past 30. Of those who had taken a New York State medical cannabis product (96%), 62% took a high THC formulation, 57% took a 1:1 THC:CBD formulation, and 40% took a high CBD formulation.

In New York, early adopters of medical cannabis are predominately white, higher income, highly educated, and frequently take opioid analgesics.

Value-Added Venues: Inventory of Social Cannabis Consumption Options

Lloyd Covens, West420 Media

In 2017, following favorable voter initiatives, the advent of cannabis consumption in social cafes and clubs will become a consumer option in Colorado and California. Among the timely questions for social consumption designers and planners are: Which key services and products will deliver prospective cannabis customers the greatest value in their local venues? Looking at social cannabis venues, what elements of design and environment are most favorable for customer interaction and retention? The study will count and weigh value-added markers to offer measurement guidance which for projecting the impact of various the cannabis options for single versus multi-dimensional activities, the nature of costs and benefits (attribute-based vs. identity-based) and the role of medical versus recreational user goals. A non-alcoholic, full service multi-use center will be modeled, allowing the addition/deletion of several lifestyle, healing, entertainment and learning activities related to consumer cannabis development. Industry experts will evaluate and rank consumption venue options, and the research will then survey a limited number of typical residents and tourist-based customers to gauge their projected value assignment for each of the four activity groups. Environmental, safety and relationship-building aspects will be examined.

Cannabis Use in Multiple Sclerosis and Parkinson's Disease

Felix Proessl, Colorado State University, *Kaigang Li*, Colorado State University, *John Kindred*, Colorado State University, *Nathan Ketelhut*, Colorado State University, *William Shaffer*, Banner Health, and *Thorsten Rudroff*, Colorado State University

Multiple sclerosis (MS) is a demyelinating disease of the central nervous system that often causes muscle spasticity, difficulty walking, impaired leg strength, and fatigue. However, current treatments do not adequately relieve these symptoms. The American Academy of Neurology currently supports cannabis as a treatment of spasticity in MS. However, it remains unknown whether reduced spasticity with cannabis use leads to improved physical function.

The purpose of this study was to compare physical function between patients with MS who do and do not use cannabis to treat their symptoms. Seven patients who report using cannabis to treat their symptoms (5 women, 51.4±11.5 years, disease duration: 10.7±6.7 years) and 7 patients who identify as cannabis naïve (5 women, 52.1±11.9 years, disease duration: 10.9±5.6 years) participated in the study. A total of 12 tests were conducted to assess disability status, fatigue, fall risk, spasticity, mobility, arm/hand function, lower/upper body strength, and physical activity. All comparisons were made using 2-tailed T-Tests.

Total spasticity of the lower body was lower in the cannabis users compared to the non-users ($p=0.05$). Cannabis users tended to perform better on tests assessing walking speed, perceived risk of falling, and leg strength ($p<0.01$). Importantly, cannabis users did not perform worse than non-users on any of our measurements. These preliminary results suggest that cannabis may improve physical function

in patients with MS. Larger studies are needed to determine the underlying mechanisms of improved mobility with cannabis use and whether cannabis should be prescribed to treat impaired mobility in patients with MS.

Fine Monitoring of Cannabinoid Concentration by HPLC During CO_2 Extraction

Brynson Lehmkuhl, Cannabis Queen

CO_2 extracted cannabis oil, made by large, close-looped systems, is becoming popular in the marijuana industry due to safety benefits, oil quality, and for being more environmentally friendly than other commonly used solvents. These systems allow for fine-tuning the machine's pressure so that cannabis plant material can be extracted at pressures where Δ9-tetrahydrocannabinol (THC), the main psychoactive component of cannabis, is more soluble in CO_2.

A common practice is to run extraction in the supercritical regime and monitor the oil yield hourly. A drawback of this technique is that, in addition to THC, unwanted plant waxes and chlorophyll are extracted thus making the precise detection of yield decrease difficult and more clean up is necessary after the extraction is complete. Due to their increased solubility at higher pressures, the ratio of THC to waxes can be low due to more plant waxes in the overall oil yield. We are using subcritical extraction to remove less wax and we quantitatively monitor the percentage of cannabinoid species hourly during the extraction. This monitoring is performed using high performance liquid chromatography and a study of the evolution of the ratios of THC, tetrahydrocannabinol acid, cannabinol, cannabidiol and cannabichromene during the extraction is under way. This method allows us to monitor the THC yield decrease on a much finer level and therefore to optimize the extraction process.

Assessing Cannabinoid Permeability in a Mouse Dermal Administration Model

Dorothy Colagiovanni, Next Frontier Biosciences, *Kris Chupka*, Next Frontier Biosciences, *Susan Schwarz*, Next Frontier Biosciences, and *Paul Johnson*, Next Frontier Biosciences

Poster: http://hdl.handle.net/10217/180255

Cannabinoids are extremely lipophilic substances with LogP values >5. This makes cannabinoids amenable to formulation only with hydrophobic preparations for topical administration. We sought to evaluate various oil based preparations of Δ9-tetrahydrocannabinol (THC). The starting formulation (base) did not have permeation enhancers while other formulations did. Preparations were analyzed by liquid chromatography mass spectrometry to confirm potency and chemical identity prior to study initiation.

Male CD-1 mice were used in the study following guidelines of humane animal use. Animals were anesthetized, dorsal regions were shaved and then tape stripped. A 200 mg sample of 0.1% THC preparation was applied to the skin of each animal. Mice were observed for signs of clinical toxicity and blood was collected by cardiac puncture 5 minutes to 4 hours post-dose under anesthesia. After blood collection, animals were humanely euthanized. Punch biopsies of the skin were then collected from each animal. Blood samples were processed to plasma and samples were treated with trifluoroacetic acid to prevent glucuronidation. Skin samples were homogenized and processed for tissue bioanalysis.

Plasma and tissues samples were analyzed for THC as well as the metabolites (±)-11-Hydroxy-Δ9-THC and (-)-11-nor-9-Carboxy-Δ9-THC by TOF liquid chromotography mass spectrometry. Results of the analysis demonstrated the ability to separate THC from its metabolites in biological samples and individually quantify them from <1ng/mL up to 500 ng/mL. The study enabled evaluation of both in vivo skin permeation and plasma concentrations of THC and its metabolites.

Development of Best-In-Class Medical Cannabis Products

Steven Cape, Next Frontier Biosciences, *Michael Mulder*, Next Frontier Biosciences, *Susan Schwartz*, Next Frontier Biosciences, *Kris Chupka*, Next Frontier Biosciences, *Paul Johnson*, Next Frontier Biosciences, and *Dorothy Colagiovanni*, Next Frontier Biosciences

At Next Frontier, our goal is to develop best-in-class medical cannabis products for the treatment of chronic pain and other indications. Product development is science-based and evidence-driven to achieve traditional pharmaceutical levels of quality or better. In our formulation development program, we use purified cannabinoids and GRAS excipients, and a high-resolution mass spectrometer with HPLC separation to evaluate product potency, stability, and chemical identity of degradants and contaminants. Furthermore, we employ statistical tools such as design of experiment (DOE) to conduct systematic, high-quality studies, which allow us to efficiently screen and optimize many formulation ingredients for improvement in bioavailability and other pharmacological properties. For example, we conducted a fractional factorial DOE screening study of eight formulation factors (water/solvent ratio, buffer type and concentration, salinity, surfactant effect, cannabinoid loading, solubility enhancer, and a permeation enhancer), which as a full factorial study would require 256 experiments. However, we determined the main effects with just 16 experiments, and conducted two confirmatory replicates. From this study, we identified a hydroxyquinone degradant of cannabidiol (CBD) under certain pH conditions and obtained a clear understanding of cannabinoid solubility in the formulation space examined. In a three-component mixture DOE, we examined the solubility of CBD at varying ratios of a solvent, co-solvent, and water from 12 runs and 4 replicates. The surface response ternary plot obtained showed the optimized ratios that maximize CBD solubility. Our analytical tools and formulation approach enable us to develop unique and unparalleled high quality cannabinoid formulations for nasal and sublingual delivery.

ICR Impact Studies

Presented at the 2017 ICR Research Reception

In the ICR's first year, ten interdisciplinary research projects began at CSU-Pueblo. Project summaries and preliminary results were presented at the ICR Research Reception hosted at the El Pueblo Museum on Saturday, April 29.

Effects of Medicinal Cannabinoids on Seizures in Adults with Medically Refractory Epilepsy

Barbara Brett, Psychology

This observational study will evaluate the effects of medicinal cannabis in an adult epilepsy group who incorporate medicinal cannabis as an adjunctive treatment for their medically refractory epilepsy (epileptic seizures that do not respond to traditional medical treatments). Participants will wear a special data-gathering wristband that will document the individual's physiological changes when experiencing a seizure. Researchers will analyze how the use of medicinal cannabis impacts adults with epilepsy, including reported side effects, and one's overall quality of life.

Industrial Hemp Fibers as Reinforcing Agents in 3D-Printing Filament Composites

Nebojsa Jaksic, Engineering, and *Melvin Druelinger*, Chemistry

This study investigates the possibility of industrial hemp fibers as viable replacements to wood when introduced into 3D printing filament composites, as hemp is less expensive than wood and more environmentally friendly. The results of this research will generate further knowledge of new polymers and reinforcing agents for industrial use.

Infrastructure Development for Cannabis Growth and Research at CSU-Pueblo

Brian Vanden Heuvel, Biology, *Jeffrey P. Smith*, Biology, and *Chad Kinney*, Chemistry

This project involves: (1) greenhouse expansion; (2) genome sequencing of 14 varieties of cannabis to create tools for future breeding; (3) extraction and quantification of cannabinoids from hemp; and (4) assessment of biological activity of known and novel compounds from cannabis as modulators of brain cell function in the limbic system receptors in mice.

Development of an Enhanced Extraction Method for Cannabidiol (CBD) and other Cannabinoids from Cannabis Leaves and Flowers Using Pressurized Liquid Extraction

Chad Kinney, Chemistry

There are numerous methods for extracting CBD from hemp leaves for multiple uses including medicinal applications. This research will seek to optimize a novel and semi-selective extraction method for CBD and other cannabinoids, and compare results against existing methods to assess the potential utility of this new method for use with industrial applications.

Creation of a K-12 Cannabis Research Pilot Study

Tim Peters, Teacher Education, *Jenny Piazza*, Teacher Education, *Sue Pettit*, Teacher Education, *Margie Massey*, Teacher Education, *Jeremiah Blaha*, Teacher Education, *Bethany Kies*, Exercise Science and Health Promotion, *Jeff Piquette*, Teacher Education

This project involves an analysis of existing data on marijuana use among minors, vicinity of dispensaries, and other community demographic data; a survey of Colorado schools to determine the type of marijuana and g education curricula used; and a study of the effectiveness of specific marijuana and drug education curricula.

Investigating the Role of Endocannabinoid-Induced Metabolic Changes on Viral Infection

J. Jordan Steel, Biology

Viruses negatively impact cells during infection, and viruses and endocannabinoids both alter cellular metabolism. This research will investigate how two specific viruses are either inhibited or enhanced by the activation of a specific cannabinoid.

Phytoremediation of Municipal Sewage Sludge Using Industrial Hemp to Divert Organic Carbon-Rich Biosolids from Landfills

Brian Vanden Heuvel, Biology

This project is designed to determine the utility of using industrial hemp as a remediation tool for municipal sewage sludge so that it will meet regulatory requirements for land application.

Analysis of the Types of Jobs Being Created in Pueblo County's Cannabis Industry

Brad Gilbreath, Business

Poster: http://hdl.handle.net/10217/180353

The goal of this research is to gain an understanding of the types of jobs being created by the cannabis industry, to include pay, hours of work, job security, prospects for promotion and other indicators of job quality.

Public Health and the Health Care System Benchmark Studies

Joe Franta, Nursing, *Jacinda Heintzelman*, Nursing, *Lisa Persons*, Nursing, and *Leslie Murtagh*, Nursing

This project is examining several aspects of health care and the health care systems as it relates to cannabis use. Specific data sets will be utilized from Pueblo County provider sites including primary care, obstetrics and the emergency room. This data is retrospective, quantitative and non-experimental focused on residents of the county. In addition a survey will be utilized to gain understanding of the perception from individuals using recreational and/or medicinal cannabis.

Corporate Panels

That's Natural 'Legal' Cannabis

Tisha Casida, That's Natural

Presentation: http://hdl.handle.net/10217/180355

What is Food and Medicine Freedom? Non-psychotropic cannabis (like hemp) and its natural plant compounds have proven benefits for people's quality of life. Are you ready to practice peaceful civil disobedience and stop asking government for their blessing if someone's life depends on it?

Responsible Use: Cannabis and Public Safety

Ralph Morgan, Organa Brands

Organa Brands CEO Ralph Morgan discusses the role of the entrepreneur in the frame of responsible use. Morgan furthers the discussion with regards to how responsible use is good for business and consumers. Joined by other thought-leaders in the industry, this panel opens up a much-needed dialogue about the roles of various stakeholders, and the important role they play in uniting an industry behind public safety and smart regulation.